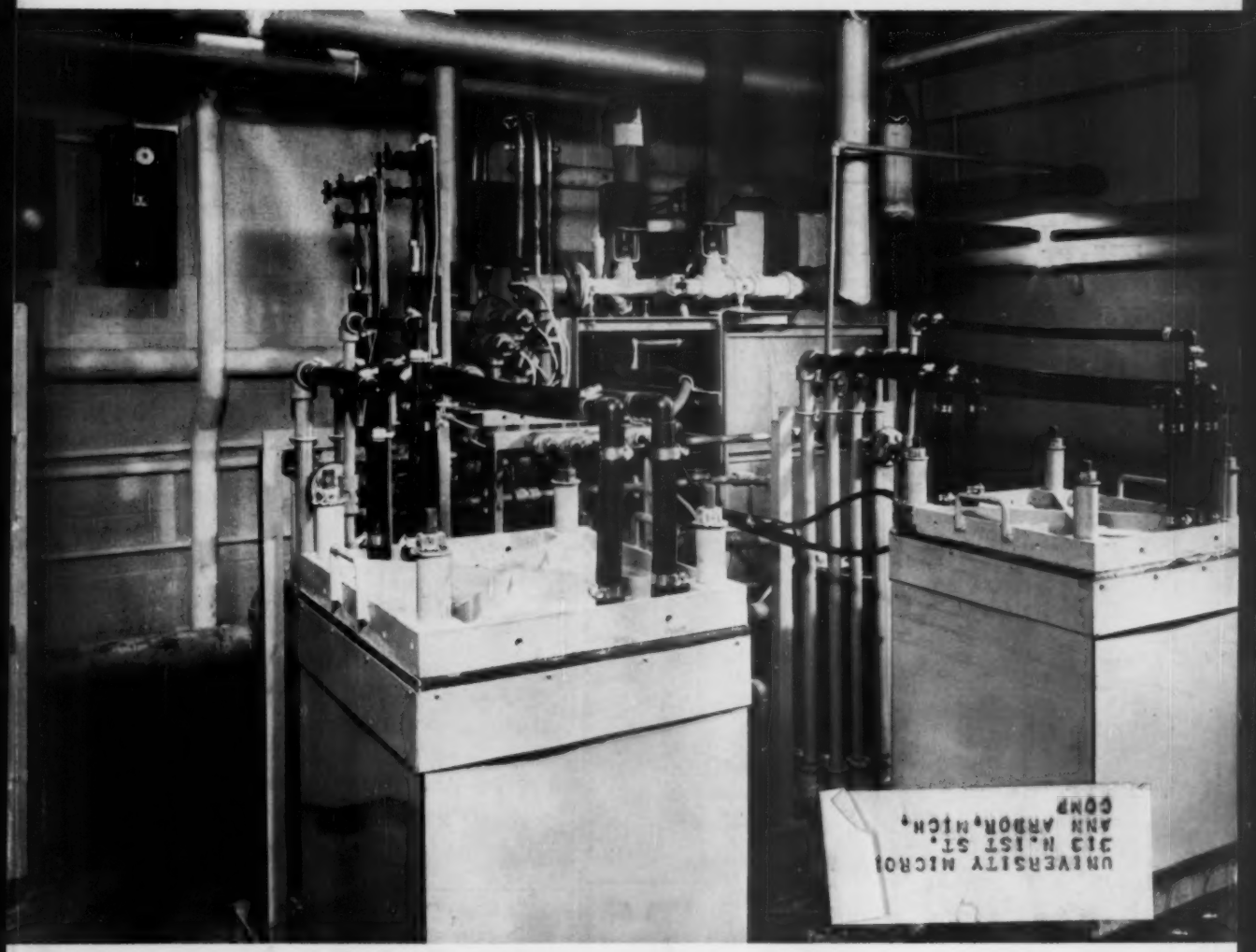
A Scranton Gillette Publication

FEBRUARY 1959

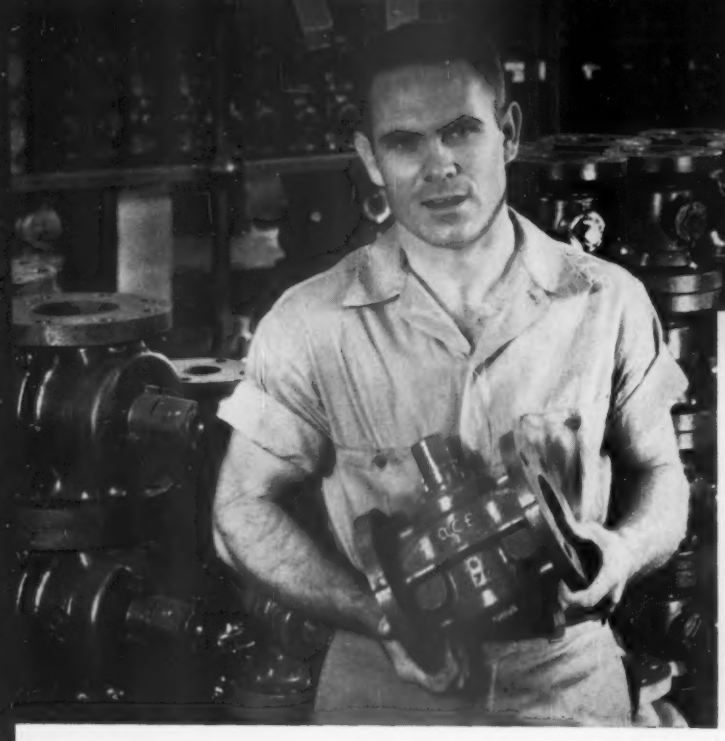
WATER & SEWAGE WORKS

WATER SUPPLY SEWAGE DISPOSAL



▲ **SALINE WATER may be converted to fresh by such promising processes as this Ionics Inc. installation which treats brackish well waters.** **See article on p. 94.**

ACF Lubricated Plug Valves



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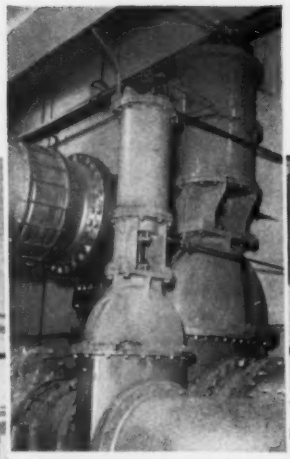
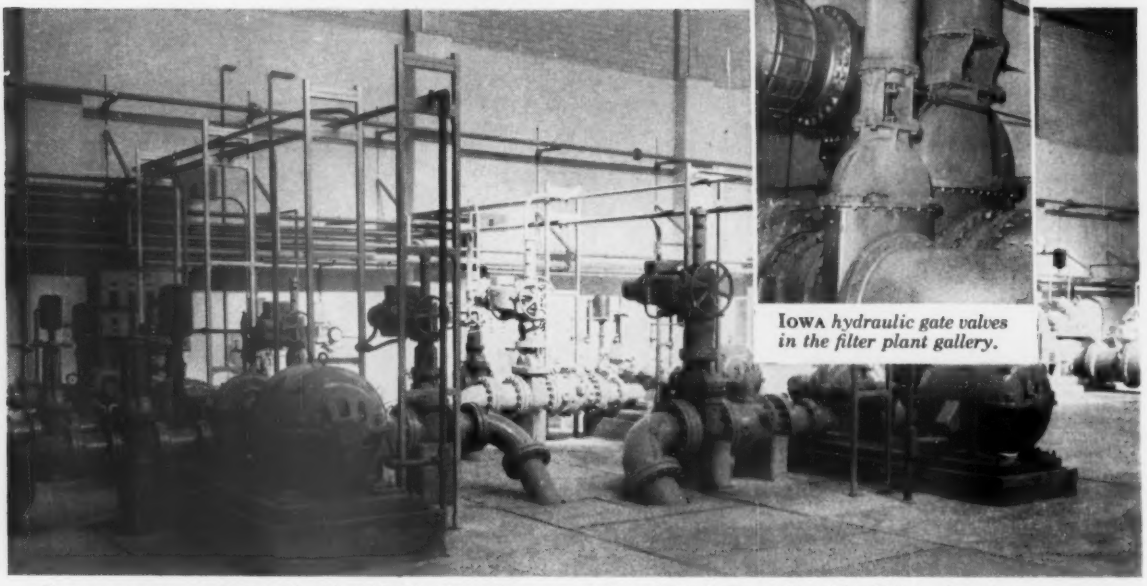
40 IOWA GATE VALVES...



IOWA *hydraulic gate valves in the filter plant gallery.*



IOWA *motor-operated gate valves installed in the main pump station of North Texas Municipal Water District. (General Manager: Mr. A. P. Rollins; Consulting Engineers: Forrest and Cotton; Design Engineer: Mr. Ormond A. Stone.)*

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Vol. 106 No. 2

FEBRUARY • 1959

A Scranton Gillette Publication

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WATER & SEWAGE WORKS

REGULATION *of Water Resources*
by **Abel Wolman** 53

PLANNING WATER SUPPLY RESOURCES *to meet expansion*
by **John E. Kiker** 56

AUXILIARY BEACON LIGHTS
by **Paul C. Ziemke** 59

SUBTERRANEAN WATER COLLECTOR
by **H. Fehlmann and J. H. Fehlmann** 60

ELEVATED TANK MAINTENANCE
by **E. D. Barrett** 65

WATER FOR SUBDIVISION HOUSES
by **Carlyle Washburn** 69

FLOW OF WATER FROM HYDRANTS, *a nomograph*
by **D. S. Davis** 70

CHLORINE HANDLING and STORAGE, *third in a series*
by **E. J. Laubusch** 71

WATER SYSTEM OPERATION
by **R. L. Brown** 78

MECHANISM OF CORROSION
by **Arthur G. Keller** 79

SALINE WATER CONVERSION
by **Sheppard T. Powell** 84

WATER WORKS MANAGEMENT
a **meeting report on Ill. Short School** 87

METAL MEDIA VACUUM FILTERS *for sludge dewatering*
by **K. B. Singleton** 91

RADIATION DETECTION *in water supplies*
a **meeting report on N. J. Sect. AWWA** 94

POLYELECTROLITES, RADIOACTIVITY
a **meeting report on Fla. Sect. AWWA and Fla. SIWA** 95

ECONOMICAL SEWAGE TREATMENT PLANTS
by **J. H. Greenleaf** 96

THE EDITOR'S COMMENTS 98

News — Here & There 7A
Equipment News 13A
News of Suppliers 30A
Meeting Calendars 88A
New Bulletins 92A

Here is one of the aeration tanks in Kewanee, Illinois, using the P.F.T. Dual Aeration Equipment. Crawford, Murphy and Tilly, Consulting Engineers, Springfield, Illinois.

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BRIEFS

The 1958 Annual Index for Water & Sewage Works is now available. If you wish a copy, write to our editorial office at 155 E. 44th St., New York 17, N. Y.

Regulation of Water Resources discusses the need for constant awareness by everyone where legislation pertaining to water resources is being considered. Cases are presented showing where hastily conceived legislation, usually passed during periods of stress, have created situations that would override many years of previous court decisions and statuatory provisions, if adhered to in their present form—page 53.

Planning Water Supply Resources to meet expansion is a must for water works managers, for the public's tendency to consider the tap as the source, and to think no further, is dangerous. Engineers will find a need for accurate estimates of future water consumption and therefore must make use of all existing analyses and forecasts he can—page 56.

Auxiliary Beacon Lights need an automatic cut in circuit as is described —page 59.

Subterranean Water Collector system as developed in Switzerland includes some features not heretofore used in America—page 60.

Elevated Tank Maintenance needs a sound program of preventive maintenance. This article sets forth some basic principles and includes a standard inspection report form—page 65.

Water for Subdivision Houses is a problem to those who have to administer water supplies for housing developments. Here are three approaches to the problem—page 69.

Flow of Water from Hydrants can be determined from a nomograph —page 70.

Chlorine Handling and Storage requires attention to details to insure safe and effective operation of the chlorination process in water and sewage plants. In this third article in a series, the fundamentals of this phase of the general subject are given—page 71.

Water System Operation is directly affected by the termination of television programs as shown by observations in Wichita, Kan.—page 78.

The Mechanism of Corrosion must be understood both as to how and why in order to explain many problems. This article reviews basic fundamentals and explains techniques to overcome corrosion troubles —page 79.

Saline Water Conversion is under intensive study in many parts of the country. This article reviews some of the more encouraging studies and equipment likely to become economically feasible—page 84.

Water Works Management was the subject of a short school held by the University of Illinois under the sponsorship of the Ill. Section AWWA. This report covers that meeting—page 87.

Metal Media Vacuum Filters are used for sludge dewatering at Middletown, Ohio where the domestic sewage contains paper mill wastes. These wastes increase the quantity of sludge to be dewatered. Reclaimed lime from the Dayton Water Softening Plant is used to condition sludge for dewatering on coil filters—page 91.

Radiation Detection in Water Supplies was one of the principal topics discussed at the N. J. Section AWWA meeting—page 94.

Polyelectrolites and Radioactivity were among the topics discussed at the joint meeting of the Fla. Section AWWA and the Fla. SIWA. A brief report on this meeting appears on page 95.

An Economical Sewage Treatment Plant for small housing developments utilizes a combination of a new design, common wall construction, and strict adherence to specifications—page 96.

The Editor Comments on the Illinois Water Works Management Short School—page 98.

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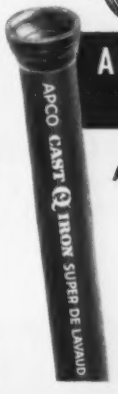

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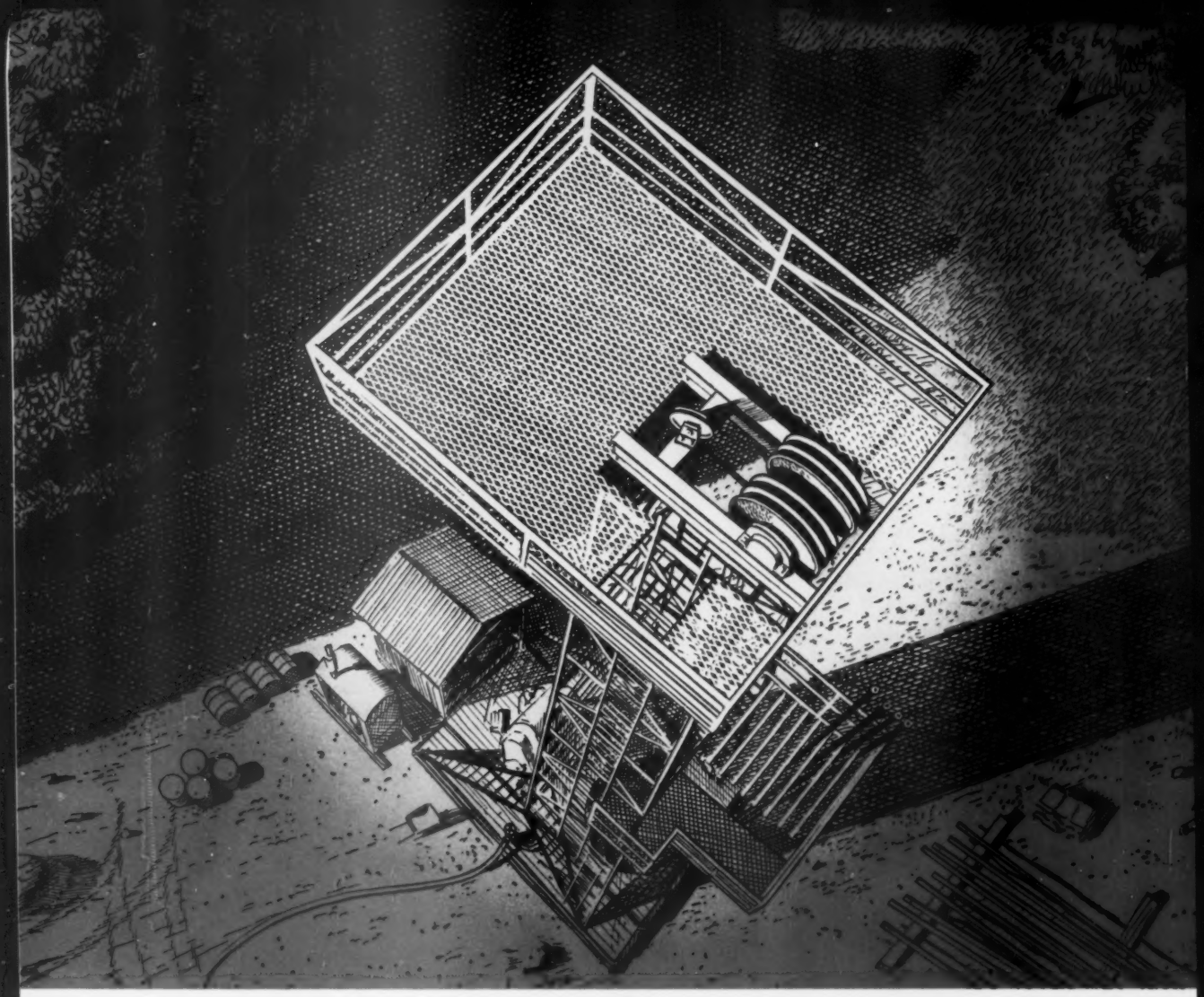

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News—Here & There

Henry F. Munroe Elected President of NESIWA

Henry F. Munroe of Cranston, R. I., was elected 1959 President of the New England Sewage & Industrial Waste Association at that group's annual meeting in Hartford, Conn. Mr. Munroe is a Sanitary Engineer in the Utilities Sales Department at B-I-F Industries, Inc.

Mr. Munroe—who has been a Control Chemist in a dyeing and finishing plant, a Plant Chemist at Koppers Co. and a Lab. Assistant and Junior Chemist for the U. S. Rubber Co.—has long been interested in water treating problems. He joined B-I-F Industries, Inc., in March, 1941 and has been a Sales Engineer, Office Manager, Research and Development Director, Project Engineer and finally a Sanitary Engineer. He is the holder of patent #2-749222 for a Saturator, granted in June, 1956. In 1957 he received the Arthur Sidney Bell Award for service to NESIWA, and in Spring, 1958, he was made a "Diplomate" of the American Inter-Society Board of Sanitary Engineers.

Mr. Munroe graduated from the University of R. I. in 1934 with a B.S. degree in Chemical Engineering. He attended Northeastern and Brown University for additional studies. He is a Registered Professional Engineer in R. I. and has authored numerous papers and articles published in trade publications. A community-conscious man, Mr. Munroe is active in Civil Defense, the R. I. Hospital Building Fund, the YMCA. He is member of more than eleven business, professional and civic organizations. Recently he was elected a Fellow of the American Public Health Association.

Hydraulic Research

A Book on Hydraulic Research in the United States 1958, edited by Helen K. Middleton, National Bureau of Standards, Miscellaneous Publication 224, is now available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. The book consists of 168 pages and sells for $1.25 per copy.

This publication, the latest in a series of annual publications dating back to 1951, contains reports on hydraulic research conducted within the past year in the U. S. and Canada. The project reports give the sponsor of the project, the nature of the work, a brief description of the process, the present status and results of the work, and any publications which have been written as a result of the project.

Further information on the projects can be obtained by writing directly to the organization carrying on the project. For this purpose, full addresses of all cooperating laboratories are given.

Pressure Changes at Storm Drain Junctions

Engineering Series Bulletin No. 41, Pressure Changes at Storm Drain Junctions, by W. M. Sangster, H. W. Wood, E. T. Smerdon, and H. G. Bossy, is now available from the Engineering Experiment Station, University of Missouri, Columbia, Missouri.

The report is on research sponsored jointly by the Missouri State Highway Department and U. S. Bureau of Public Roads. Model studies determining pressure changes at various rectangular and circular junction structures are presented. Also included is a design section embodying detailed procedures and working charts for use in the design of storm drain junctions. Price, complete report $2.00; Design Methods only $1.00.

Ontario Water Resources Commission

The Ontario Water Resources Commission, Toronto, Canada, has released a booklet that outlines the objectives of the commission and sketches the methods proposed in reaching these objectives.

Also described in the publication are the commission's facilities which are available to municipalities with water or sewage problems and industries with waste disposal troubles.

Thomas Quigley Elected V.P. of Wallace & Tiernan

The Board of Directors of Wallace & Tiernan, Inc., Belleville, N. J., recently elected Thomas T. Quigley, Vice-President-Equipment Divisions. Mr. Quigley assumed his new duties on January 1, 1959. He is responsible for all operations of the company's equipment divisions.

Mr. Quigley has been associated with Wallace & Tiernan since 1940. He graduated from the Virginia Military Institute in 1935 with a B.S. degree in Civil Engineering. Mr. Quigley resides at 65 Winding Way, West Orange, N. J.

N. J. Water Conferences

The New Jersey Water Conference has announced that meetings during 1959 are scheduled for February 6th and 20th, March 6th and 20th, and April 3rd and 17th.

Research to Classroom

The U. S. Public Health Service, Div. of Sanitary Engineering Services, has available a booklet titled From Research to Classroom Laboratory.

The booklet, which consists of a series of articles previously published in "The Science Teacher," represents the results of a program of collaboration between research scientists, engineers, and technicians on the one hand, and science teachers on the other.

The program is currently in operation in Cincinnati, Ohio at the Robert A. Taft Sanitary Engineering Center. Through a unique arrangement, key secondary school science teachers in Cincinnati are being exposed to the Center's unusual facilities and staff. The purpose is to assist teachers in developing current, practical, and interesting supplementary laboratory exercises.

CONTINUED ON PAGE 9A

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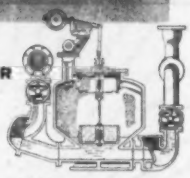

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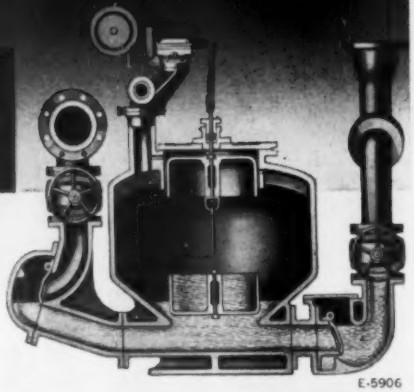

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News—Here & There

CONTINUED FROM PAGE 7A

Earl Devendorf Retires

After more than 40 years of service, Earl Devendorf has retired as director of the Bureau of Environmental Sanitation for the New York State Department of Health.

Joining the department in 1918 as an assistant sanitary engineer, Mr. Devendorf was appointed assistant director of sanitary engineers in 1928, and became director in 1948.

Mr. Devendorf is a member of the Conference of State Sanitary Engineers, AWWA, ASCE, New York State Society of Professional Engineers, the New York State Public Health Association, and is a fellow of the American Public Health Association.

Sewage & Stream Course

The Bayerische Biologische Versuchsanstalt, Munich, Germany, has announced an Introductory Course on Biology of Sewage and Stream Sanitation, to be held on March 2-6, 1959, under the direction of Professor Dr. R. Demoll and Professor Dr. H. Liebmann.

The course will cover the special problems of the biology of sewage and pollution control by microscopical training practice with the different sampling devices and discussions.

It was also announced that an advanced coure on the "Possibilities and limits in removing poison and radioactive substances from sewage and industrial waste water," would be held on October 5-10, 1959.

For further information contact Prof. Dr. H. Liebmann, Bayerische Biologische Versuchsanstalt, Munich 22, Veterinarstr, 13.

South Calgary Sewage Plant

The city of Calgary has announced the appointment of Haddin, Davis & Brown (Alberta) Limited as engineers to design and supervise construction of a $400,000.00 sewage treatment plant in South Calgary.

The plant will be designed to process sewage from new subdivisions springing up in the South Calgary area including Fairview and Haysboro.

Haddin, Davis & Brown (Alberta) Limited were consulting engineers for the City on the recent expansion of the main Calgary Sewage Treatment Plant.

No-Sewers—No-Water

The City of Cleveland, Ohio, has recently taken action to make its "no-sewers-no-water" policy 100 per cent effective.

The City Department of Public Utilities notified suburban mayors in one-paragraph letters that it was discarding more than 200 plans for water main installations in projected real estate developments.

Representing millions of dollars in construction costs, the plans have been on file with the city for more than two years. They were presented before former City Utilities Director Emil J. Crown issued an order that no new water installations would be made before the suburbs built sanitary sewer systems. Crown had agreed to permit the suburbs to complete plans on file before his "no-sewers-no-water" rules was declared on August 10, 1956.

The most recent order discarded the plans that were on file before the 1956 date and for which contracts had not been signed. The order was signed by Acting City Water Commissioner Vincent J. DeMelto and City Utilities Director Bronis J. Klementowicz.

Klementowicz said that plans for the 200 projects, which are located in all parts of Cuyahoga County, would not be approved again unless they included sewer installations. Issuing a special warning to persons planning to buy property, he said they should make sure the home or lot is served by sanitary sewers. "If the property is equipped with a septic tank," he said, "they won't get any water from the city of Cleveland."

Under the new order, Klementowicz could halt virtually all new home construction in the Cleveland area where sanitary sewer systems are not provided. The new order should force communities to build their own systems or join existing systems.

Annual Index

The 1958 Annual Index of Water & Sewage Works is now available and may be obtained by writing our editorial office at 155 E. 44th St., New York 17, N. Y.

Sanitary Engineer Examinations U.S.P.H.S. Regular Corps

A competitive examination, for appointment of Sanitary Engineer Officers to the Regular Corps of the United States Public Health Service, will be held in various places throughout the country on April 21, 22, 23, and 24, 1959.

Appointments will be made in the ranks of Assistant and Senior Assistant grades. Requirements for both ranks are United States Citizenship and graduation from a recognized engineering college or university. Applicants for the Assistant Sanitary Engineer Officer rank must be at least 21 years of age and have at least three additional years of professional training and experience. For the Senior Assistant Sanitary Engineer rank, an applicant must meet the requirements for the Assistant Rank and must have at least three additional years of professional training and experience.

Application forms may be obtained by writing to the Surgeon General, United States Public Health Service (P), Washington 25, D. C. Completed application forms must be received in the Division of personnel no later than March 6, 1959.

Minnesota

According to Chester Wilson, a special assistant attorney general assigned to the Minnesota Water Pollution Control Commission, the Minnesota legislature will have to pass an enabling act to give smaller communities the power to join in cooperative control of water pollution.

The Water Pollution Control Commission also approved a tentative priority list of communities which applied for federal aid under the federal water pollution control law for the construction of sewage treatment facilities. The priority list includes 46 communities whose requests for aid totaled $4,243,011.

CONTINUED ON PAGE 11A

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The exclusive and patented coal tar-epoxy resin coating that has revolutionized the control of severe corrosion. Tarset provides excellent protection against petroleum crudes, hydrogen sulfide, brines, gasoline and many other corrosive agents.

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A series of vaporseal, condensation control and insulation coatings. Special Gilsonite asphalt formulation makes Insul-Mastic coatings highly resistant to acids and alkalis, as well as to moisture penetration.

There's a real advantage, in economy and convenience, when you buy *all* of your heavy duty *cold applied* protective coatings from one source —your Pitt Chem Industrial Distributor. Another important Pitt Chem *plus* is the ready availability of experienced technical help, wherever and whenever you need it. For more information about your coating problems, contact your Pitt Chem Coatings Distributor today!

PITTSBURGH COKE & CHEMICAL CO.

WSW-7383

COAL CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON • FERROMANGANESE

News—Here & There CONTINUED FROM PAGE 9A

1959 Named Water Works Year

William G. Stratton, Governor of Illinois, by official proclamation has declared 1959 as Water Works Year in Illinois, in honor of the Fiftieth Anniversary of Illinois Water Supply Association.

STATE OF ILLINOIS
EXECUTIVE DEPARTMENT
Proclamation

WHEREAS, Fifty years ago next February 16, a group of 37 water works officials in Illinois, meeting with the Illinois State Water Survey, by invitation of President Edmund J. James of the University of Illinois, formally prepared and adopted the Constitution of the Illinois Water Supply Association, and

WHEREAS, This Association affiliated with the American Water Works Association as its Illinois Section in 1914, and

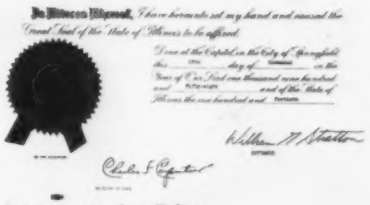
WHEREAS, Water works men from Illinois have and are actively and conscientiously engaged in developing and using advanced knowledge relating to water supplies and the conservation of water supplies for public use, and

WHEREAS, These men can be justly proud of their contributions toward the future of Illinois, and

WHEREAS, These efforts and achievements should be a matter of public information for all citizens who enjoy the convenience of pure water at their household tap, and

WHEREAS, It is a matter of public interest for citizens and civic leaders to acquaint themselves with, and support planned water works development for community growth and well-being,

NOW, THEREFORE, I, William G. Stratton, Governor of the State of Illinois, do hereby proclaim the year, 1959, as Water Works Year in Illinois, with appreciation to all water works men for their continuing loyal public service, upon this Fiftieth Anniversary date of organization.



Letters to the Editor

Dear Dr. Symons:

"Commenting on your editorial in the November issue, entitled, 'Who Will Replace Them?', I am setting down a few thoughts about how we, in Florida, are very seriously engaged in recruitment for tomorrow's operators, superintendents, and sanitary engineers.

At a recent meeting I discussed with James Pounds, Plant Superintendent of Pensacola, Florida, his in-plant training program. Mr. Pounds informed that arrangements had been made with the authorities of the Board of Education for students from the high schools are now given class credit for work that they do in the laboratories at the water and sewage plants. Also, those who are attending vocational schools would have a definite assignment at these plants where they learn practical pump mechanics, plant hydraulics, etc. Mr. Pounds also informed me recently that they have gone one step further for the men already employed. The City of Pensacola is paying for night school courses relating to their jobs. The same program of high school and vocational school cooperation has been implemented with the cooperation of the Jr. College at Panama City, Florida. This program is under the direction of Mr. Harry Berkstresser, Director of Public Utilities.

In Lake Wales, Mr. Sam Robinson secured the high school cooperation, and they are sending students under the D.C.T. program, (Diversified Cooperative Training). Aside from recruiting the school our group, the Florida Water & Sewage Works Operators Association has a very intensive certification program. In District Five for the Spring short course there were 195 registrants, and the current short course has the astounding figure of 235 paid registrants. To my knowledge, this will bring the year's total for the five Florida Districts to well over 1000 paid registrants. The success of this program is due in a large measure to the splendid help and cooperation of the Florida State Board of Health. As I travel through the State, I keep talking up public relations with especial emphasis on bringing the high school students into the water and sewage works field.

Dr. Symons, I feel sure that what we are trying to do here in Florida can be done in the other 48 states, and that there need be no dearth of personnel to design, operate, and superintend our plants in the future.

Very truly yours,
INVEX, INC.
Mac Grossman
General Manager

Missouri

An opinion handed down by the Missouri attorney general's office ruled that state agencies are required to obtain permits for construction of sewage disposal systems and to discharge waste into public waters, but that under a Congressional directive to cooperate with the state, federal installations are not subject to such requirement.

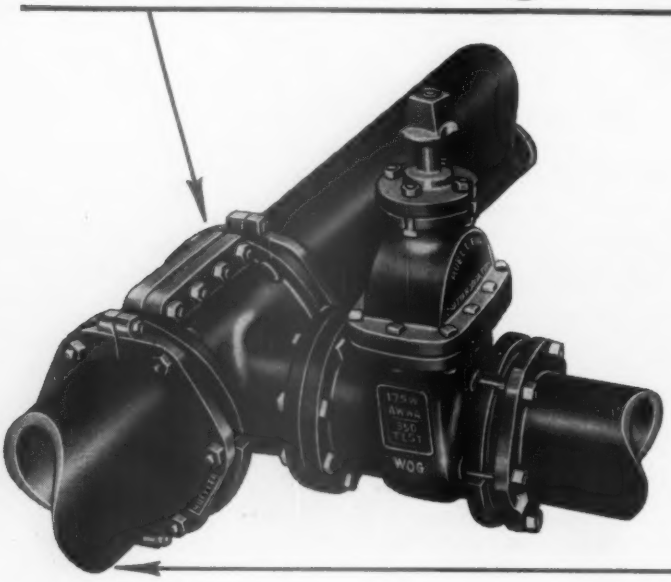
Written by Assistant State Attorney General James B. Slusher, the opinion was requested by Dr. J. M. Hardwicke, acting director of the State Division of Health, who raised the question of state requirements under the water pollution act with reference to Whiteman Air Force Base, Fort Leonard Wood, and the state hospitals at Farmington and Nevada.

The opinion said that the Missouri water pollution act of 1957 established a public policy of restoring and maintaining a reasonable degree of purity in the waters of the state and is sufficiently broad to include state agencies and institutions.

But under an act of Congress, the opinion said, federal agencies in Missouri are directed to cooperate with the state in the prevention and control of water pollution.

The attorney general's office said it understood that federal agencies in Missouri were cooperating and accepting Missouri standards. So far, it added, no situation had arisen that would, under state law, require federal agencies to construct or maintain facilities of a specific type.

one tapping sleeve ...



fits all classes of cast iron pipe regularly used.

MUELLER® Tapping Sleeves and Valves provide a means of running a lateral with a minimum of inconvenience and they offer *extra* user benefits. The tapping valve has the exclusive four point wedging mechanism. The tapping sleeve has extra length and heavy duty construction so as to actually strengthen the main at the point of connection. A Mueller Mechanical Joint Sleeve for a specific nominal size will fit all classes of cast iron pipe regularly used by employing one of two sets of gaskets. If there is any doubt as to the class of pipe which will be uncovered, the operator takes both sets of gaskets to the job site, then uses the proper set, designed to fit that specific pipe. For example: Use the duck-tipped gaskets for centrifugally cast pipe; use the plain end gaskets for class D pit cast pipe.

This simple detail of design is typical of many extra features of Mueller Tapping Sleeves and Valves and Tapping Crosses. It is also typical of the great attention to detail in research, design and engineering that becomes a part of every Mueller product used by the water industry.

MUELLER CO. DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles;
In Canada: Mueller, Limited, Sarnia, Ontario

Equipment News

Diatomite Pressure Filter For Larger Swimming Pools

201

Romar Filter Corp., Milwaukee, Wis., has developed a new intermediate size Diatomite pressure filter designed for swimming pools requiring a filtration rate of 4000 to 7000 gallons per hour, or multiples.

Known as the Suburban, the unit is of characteristic Romar Down-flow design and is built in two models with average capacities of 4200 and 7200 gallons per hour, and filtering surfaces of 35 and 60 sq ft. It is said to provide maximum filter area, longer operating cycles, slower pressure-rise and extremely compact design. The larger model needs only 9 sq ft of base space and 5 ft 6 in. headroom.

Either model can be mounted in banks of two or more units for higher, more flexible filtering requirements where increased capacities are needed. Pools with capacities of 20,000 to 80,000 gallons can be handled by single units; tandem installation handle pools

of 125,000 gallons capacity and upward. Cleaning time is only 10 minutes.

Thermo-Drive Actuator

202

Swartwout Co., Cleveland, Ohio, has developed a powerful new actuator which utilizes the expansive force of Freon vapor to position valves and other final control elements with precise and repeatable accuracy.

Called the Thermo-Drive Actuator, the new device uses no compressed air, motors, gear trains, pumps, oil, amplifiers, or relays of any kind. Precise full-balance positioning is possible at any point within the limits of the actuator.

The operating principle of the actuator is based on the controlled rate of heat release through a fluid medium, Freon, circulating in a closed chamber open only to a condenser. Within the Freon-filled chamber there is a heavy spring bellows coupled to an actuating stem and to a mechanical position-feedback device.

The Freon is continuously vaporized by an integral heater; this creates a vapor pressure within the chamber. Control action is achieved by varying the bleed rate of the Freon into the condenser through a release valve. The release valve is operated by a force coil responding to a command signal from a control instrument. When the bleed rate is decreased, the

CONTINUED ON PAGE 15A

"We record pump activity and measure flow with this $65 instrument"

TIME RECORDER + TOTALIZER

what T-R-T is — An instrument that automatically records on a strip chart the "on-off" time of any pump (or machine) to which it is electrically connected. Strip chart is chronologically-printed, runs up to four months without change.

what T-R-T does — Marks on chart when pump starts, how long it runs, when it stops. Elapsed time meter totals operating time. Operations counter (optional at additional cost) records number of pump starts.

how T-R-T is used — To measure flow, simply multiply rated capacity of pump per hour by hours of pump operating time. Strip chart furnishes a single-source basis for cost analysis, flow pattern, and pump maintenance. Many other applications. For full details, write for Brochure WR-1.

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657 BROADWAY, NEW YORK 12, N. Y.

MADE FOR...
YOUR ENGINE'S
Protection

MODEL AL

Any abnormal condition existing in your engine can be immediately brought under control by the operator with the use of Synchro-Start.....

AUTOMATIC ENGINE CONTROLS

Your engine can be protected by being automatically shut down at the first sign of low oil pressure, high water temperature, overspeed, etc.

The AL series of Synchro-Start Controls is made to fit individual requirements. Your specifications sent to us will bring immediate response.

Write for detailed information

SYNCHRO-START PRODUCTS, INC.
Since 1932
8151 NORTH RIDGEWAY AVENUE • SKOKIE, ILLINOIS

In BATON ROUGE, LOUISIANA

TYLOX®

Rubber PIPE GASKETS

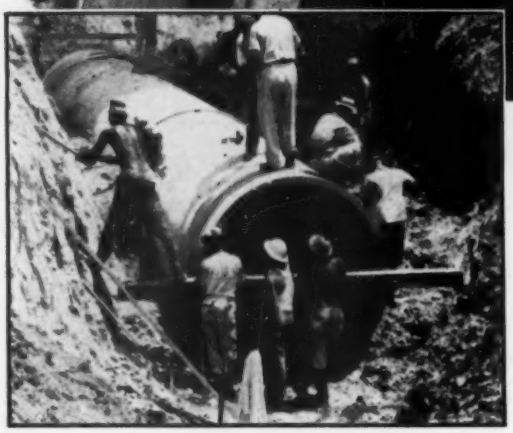
Make water-tight joints . . . speed pipe-laying in spite of tough working conditions

Gumbo! . . . wet, sticky and unstable . . . that's what faced contractors installing Baton Rouge's Longwood Drive Outfall Sewer. And the trench for the line was more like a canyon than a sewer ditch.

How were the terrific excavating costs to be offset . . . the job to be done in reasonable time . . . water-tight joints to be assured? . . . Here's how the designers' specification for TYLOX RUBBER GASKETS laid all three problems by the heels at once:

TYLOX reduces job costs with faster pipe coupling. Common delays like water and "guck" in the trench do not slow up the work. Backfill may be applied immediately. *Flexibility* of TYLOX makes the pipe line itself flexible, permitting safe compensation for pipe angularities, shifting soils and shock overloads. Water-tight joints are assured by the husky *compression* seal that follows automatically when TYLOX-jointed pipe is coupled.

Features like these are why TYLOX was specified for the Baton Rouge sewer . . . why TYLOX is the *one* pipe coupling that fully meets requirements of engineers, contractors and taxpayers alike.



* **PROJECT:** Longwood Drive Outfall Storm Sewer for City of Baton Rouge, La.

ENGINEERS: Edward E. Evans, Consulting Engineer, Baton Rouge, La., and Ray W. Burgess, Director of Public Works, Baton Rouge, La.

CONTRACTOR: J. H. Jenkins, Contractors, Inc., Baton Rouge, La.

PIPE: 72" T & G Reinforced Concrete Pipe with TYLOX Rubber Gaskets, manufactured by Anderson-Dunham, Inc., Baton Rouge, La.

GET THIS TYLOX INFORMATION FOR YOUR DATA FILES

Brochure contains engineering data and illustrated case histories showing why engineers the world over specify TYLOX get long-lasting, leak-proof pipe lines at less cost.

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KENT, OHIO

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5113

Equipment News

CONTINUED FROM PAGE 13A

vapor pressure increases, compressing the bellows and causing a downstroke. Conversely, an increase in the bleed rate will permit the bellows to expand, producing upstroke. Precise positioning of the stem is assured by the built-in feedback loop. Position repeatability is accurate to 0.5 per cent.

B-I-F Expands Butterfly Valve Line

203

B-I-F Industries, Inc., Providence, R. I., has announced the expansion of its extensive line of tight-closing butterfly valves to include a full size range of 125-pound butterfly valves. The expanded line of high pressure Builders-Providence Butterfly Valves is ideal as replacement valves, for pressure reducing and throttling functions, for street shutoff, pump discharge, altitude storage control, distribution systems, etc.

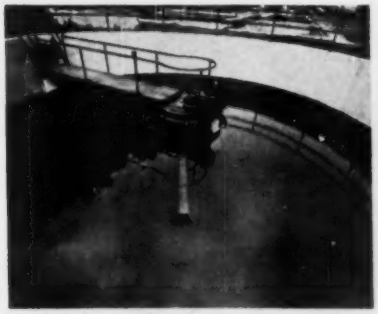
Builders-Providence 125-pound butterfly valves are for line sizes ranging from 4" to 48". They are lightweight and compact and can be supported by the line, eliminating special construction. All meet and surpass American Water Works Association specifications for butterfly valves. Efficient design and rugged construction permit burial without a vault. Shaft is one piece stainless steel, giving valve greater strength and longer life.

Similar to Builders-Providence regular line of tight closing, rubber seated butterfly valves, the 125 pound butterfly valves remain bubble tight after hundreds of thousands of operations.

Rapid Sludge Removal Clarifier

204

Dorr-Oliver Inc., Stamford, Conn., has announced the availability of the



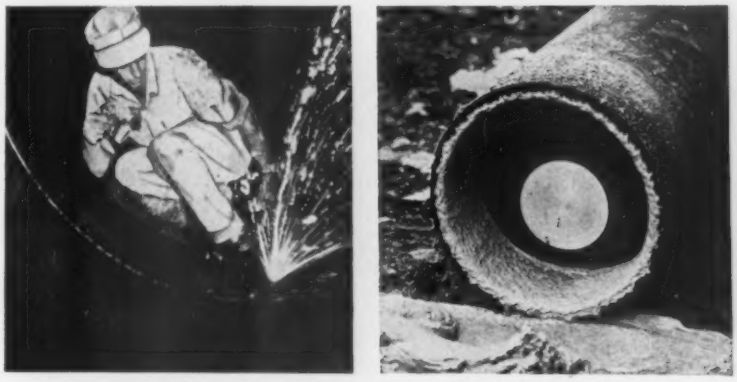
SR Clarifier, a new rapid sludge removal mechanism for final clarification in biological sewage treatment. This new clarifying unit provides immediate removal of freshly settled, biological solids for recycling to the aeration step. Presenting visible evidence of quantity and character of sludge removed, the Dorr SR Clarifier deign also allows positive control of activated sludge withdrawal.

The Dorr SR Clarifier combines the Dorr Sifeed entrance mechanism design with special modifications for rapid sludge removal. A number of deflector plates are attached to the lower edge of both rake arms and are positioned slightly above the surface of the basin floor. Vertical sludge withdrawal pipes attached to the rake arms at intervals, extend upward from the apex of each of the angles formed by the rake blade and deflector arm. These pipes terminate at the liquid surface in rotating radial collecting

CONTINUED ON PAGE 17A

Stop costly infiltration in storm drains and sewer lines with the famous

CENTRILINE PROCESS



Centrilining is effective in diameters from 6" to 144"

The Centriline Process of centrifugally applying a cement-mortar lining to pipes in place can be as effective in preventing infiltration in sewer and storm lines caused by external pressures as it is in permanently eliminating leakage in water mains caused by interior pressures and corrosion. Infiltration means over-taxed pipe line capacity and higher costs for treatment and disposal. Infiltration also results in the settlement of streets and other surfaces. Centriline's 6 million feet of pipe rehabilitation experience is on call to help with these problems.

Lining is placed when infiltration has been stopped by natural lowering of water table, plugging leaks from the interior, or by well pointing. A qualified Centriline engineer will be happy to discuss our quick and economical method of repairing concrete and terra cotta storm drains and sewer lines in sizes from 6" to 144". For further information, write today for your copy of our free booklet which fully describes the Centriline Process.

CENTRILINE CORPORATION

A Subsidiary of Raymond International Inc.

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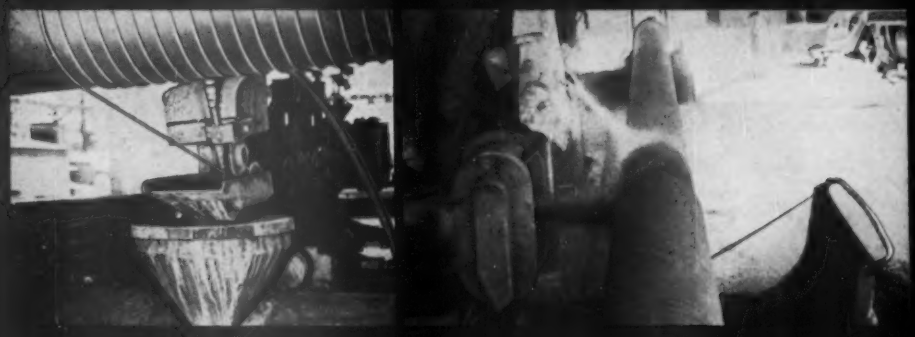
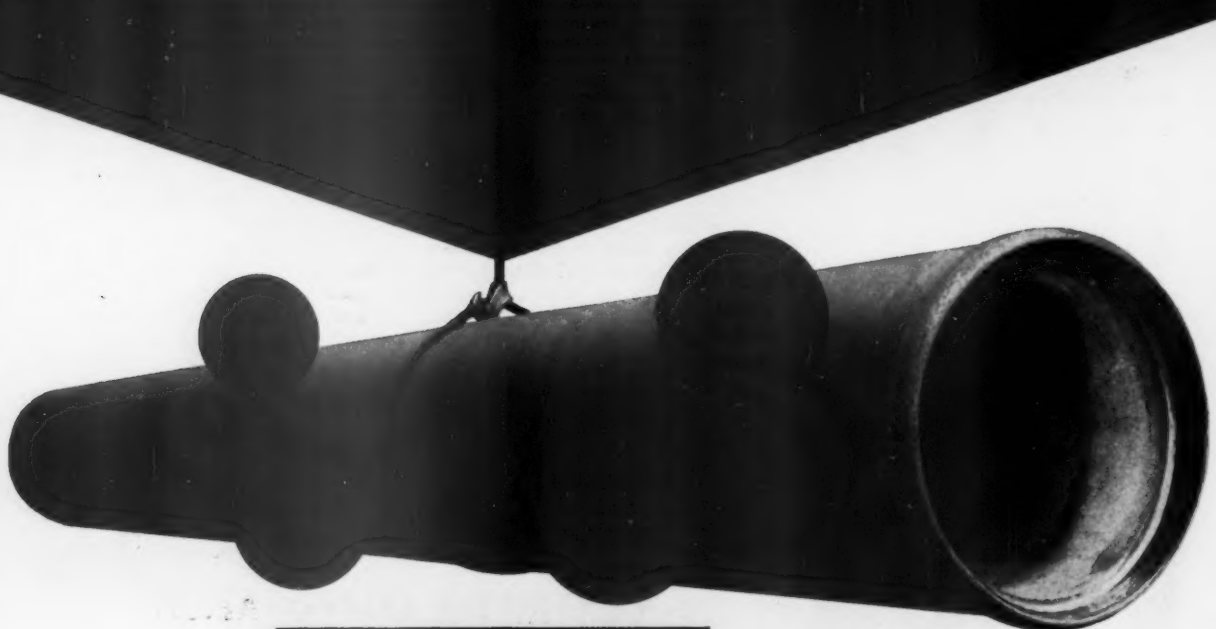
improving a superior product





Los Angeles: 4635 Firestone Blvd., South Gate, Calif., LOrain 4-2511

Hayward: P.O. Box 630—JEfferson 7-2072

San Diego: P.O. Box 13—CYpress 6-6166

Phoenix: 2025 South 7th St.—ALpine 2-1413

Portland: 518 N.E. Columbia Blvd.—BUtler 5-2531

Equipment News

CONTINUED FROM PAGE 15A

troughs attached to the arms of the Clarifier.

In operation, fresh biological active sludge which has settled to the tank floor is channeled by the deflecting plates to the open ends of the withdrawal pipes. This sludge is drawn up the pipes by head differential into the radial collection troughs. It flows to the central circular launder from which it is drawn off through the central discharge pipe. Grit and other inorganic solids are raked to a central sludge hopper and discharged by conventional means. Clarified liquor overflows a weir at the circumference of the tank.

The unique SR rapid sludge removal design is claimed by Dorr-Oliver to provide complete removal of all settled, biological active solids from the final clarification tank in a maximum of one-half revolution of the mechanism. Plows on both rake arms are located to completely sweep the basin floor in each revoltion.

Cleveland Trencher Introduces Four New Models

205

Cleveland Trencher Co., Cleveland, Ohio, has introduced four new trenchers.

All of the new models, the J-20, J-30, J-40, and JS-30, are major advances in trencher design and include

innovations in operating features which add importantly to trench digging facility and efficiency.

All new models have a new-type, V-shaped discharge conveyor which is driven, shifted and reversed in di-

CONTINUED ON PAGE 19A

Engineering PLUS...

Keeps Tank Interiors Corrosion Free at a Practical Cost

One of the five municipal tanks serving the City of Jacksonville, Fla. which has been cathodically protected by E.R.P. system since 1942.

The City of Jacksonville, Fla. has relied on engineering plus from Electro Rust-Proofing Corp. since 1942 to protect water storage tanks serving the city. Since installation of cathodic protection, tanks have been virtually corrosion free on the under water surfaces and maintenance costs have been reduced to a minimum.

E.R.P. engineering plus means cathodic protection systems
designed to meet your needs...
maintained to your benefit...
priced to your profit...

E.R.P. provides engineering plus to meet any corrosion problem of submerged or buried metals. For full information on cathodic protection for your water storage tanks, water treatment structures and pipelines, write for bulletin E-42.94.

ERP CATHODIC PROTECTION SINCE 1935

ELECTRO RUST-PROOFING CORP.
A SUBSIDIARY OF WALLACE & TIERNAN INC.
30 MAIN STREET, BELLEVILLE 9, NEW JERSEY
CABLE: ELECTRO, NEWARK, N. J.

W&T DRY CHEMICAL FEEDERS

For Accurate Feeding Of Water Treatment Chemicals

Full line of wide range dry chemical feeders capable of controlling a few ounces to 3000 lbs. per minute.

Write for Bulletin M-38 for complete Dry Feeder information.

WALLACE & TIERNAN INCORPORATED
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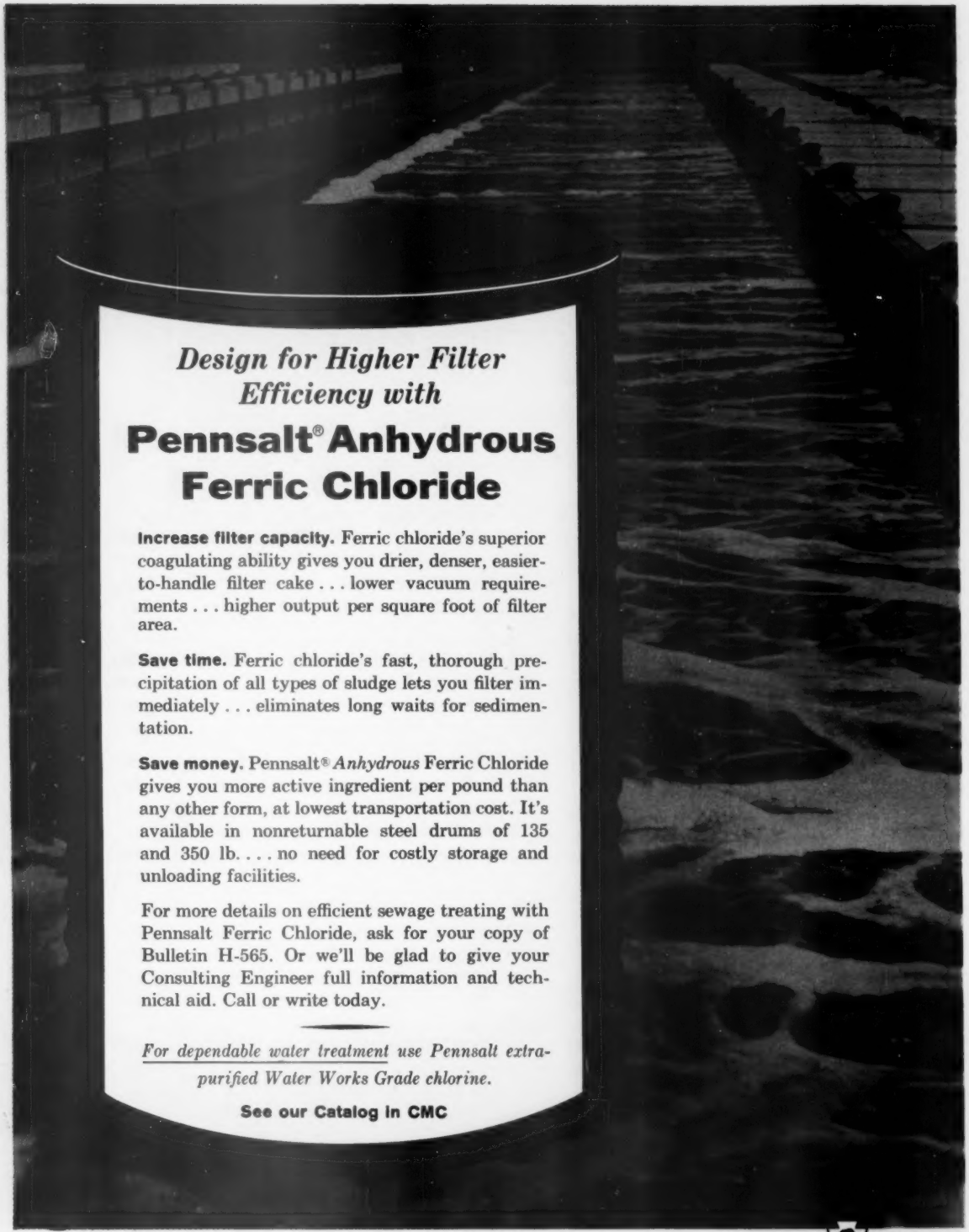

Design for Higher Filter Efficiency with

Pennsalt® Anhydrous Ferric Chloride

Increase filter capacity. Ferric chloride's superior coagulating ability gives you drier, denser, easier-to-handle filter cake . . . lower vacuum requirements . . . higher output per square foot of filter area.

Save time. Ferric chloride's fast, thorough precipitation of all types of sludge lets you filter immediately . . . eliminates long waits for sedimentation.

Save money. Pennsalt® *Anhydrous* Ferric Chloride gives you more active ingredient per pound than any other form, at lowest transportation cost. It's available in nonreturnable steel drums of 135 and 350 lb. . . . no need for costly storage and unloading facilities.

For more details on efficient sewage treating with Pennsalt Ferric Chloride, ask for your copy of Bulletin H-565. Or we'll be glad to give your Consulting Engineer full information and technical aid. Call or write today.

For dependable water treatment use Pennsalt extra-purified Water Works Grade chlorine.

See our Catalog in CMC

INDUSTRIAL CHEMICALS DIVISION

PENNSALT CHEMICALS CORPORATION

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Pennsalt Chemicals ESTABLISHED 1850

In the West, Pennsalt inorganic chemicals are available through Pennsalt of Washington Division, with plants at Tacoma, Washington and Portland, Oregon.

Equipment News

CONTINUED FROM PAGE 17A

rection of discharge by an independent hydraulic drive contained within the conveyor and lever-controlled from the operator's seat.

Their full crawlers have new-type non-packing, anti-friction-bearing-mounted tracks, dual support and drive on both ends of crawler pins, and 16 x 3 in. hydraulic steering brakes.

The new machines also have all control levels grouped for utmost safety and convenience, with all operations easily controlled from the operator's seat.

The new Model JS-30, in addition to all of these features, has a power-shifted, power-tilted digging wheel and a power-raised-and-lowered crumbing shoe. Its wheel can be shifted laterally as much as 30 inches to either side of the center line of the trencher, permitting it to dig trench flush with outer edges of the crawler tracks or at any point between. It can excavate short runs of trench up to 6 feet wide, without lateral repositioning of its crawlers.

Automatic Chemical Analysis

206

Technicon Controls Inc., Chauncey, N. Y., has developed the Technicon AutoAnalyzer, a new system for continuous automatic chemical analysis, that can detect trace materials down to parts per billion, with an accuracy of 1 per cent.

By automating each step of a chemical analysis now performed manually; i.e., measuring, mixing, purifying, processing, comparing and recording, and integrating them into a continuous flow system, the AutoAnalyzer provides accurate, dependable analysis with exact reproducibility. In the laboratory, this robot chemist runs twenty, forty, or sixty tests per hour without human supervision; tremendous economies are achieved.

In the plant, the AutoAnalyzer can be hooked up to the process or waste stream, liquid or gas. The concentration level of any material or number of materials can be continuously monitored and permanently recorded. If

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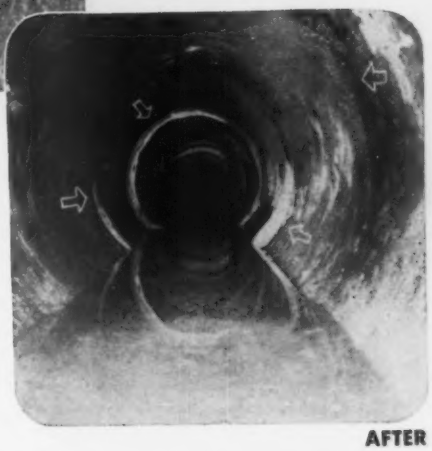
Costly waste, 20 gallons of water per minute

BEFORE

STOPPED with WATERPLUG Hydraulic Cement



AFTER

Waterplug stops running water INSTANTLY!

Here is what Underwater Services, Valley Station, Ky., had to say about Waterplug

On October 6, 1957, our Underwater Services Company was called upon to repair a major break in an underwater drainage system for the Hardin County Sportsmen's Lake at Elizabethtown, Kentucky. Upon diving to the bottom of the lake we discovered several large ruptures in the 24" tiles used in the drainage system. Water, uncontrolled, was pouring through these breaks at a minimum approximate rate of 20 gallons per minute. Using underwater diving equipment we managed to reduce this torrent by packing sandbags into the holes channeled through the four feet of earth covering these tiles. Descending through a water control tower, we gained access to the interior of the drainage tiles to the area of break-through. Above us were four feet of lake bottom and 20 feet of water above that. Under these extremely adverse conditions we used the Thoro System WATERPLUG Cement to repair the breaks from the interior of the tiles.

Because of the simplicity and ease of mixing and applying WATERPLUG Cement, we were able to completely and effectively repair these breaks in the drainage system.

We were delighted with the effectiveness of WATERPLUG Cement in successfully overcoming this difficult water repair problem. Feel confident that in future underwater repair problems, our company will rely upon WATERPLUG Cement.

"How to do it" GET OUR 16 PAGE BROCHURE

STANDARD DRY WALL PRODUCTS, INC.
NEW EAGLE, PENNA. CENTERVILLE, IND.

THE FACTS ABOUT

FRESH SOLIDS DEWATERING

No. 1 OF A SERIES

Thirty-six municipalities are now proving the advantages of raw sewage sludge (fresh solids) dewatering on Coilfilters, in terms of; lower initial investment, ease and economy of operation, lack of nuisance.

LOW INSTALLATION COST A Coilfilter-equipped fresh solids dewatering plant costs less to install than a system including digesters and sand beds. Fewer structures and less land area are required. The capital investment needed is well within the reach of small and medium-sized communities.

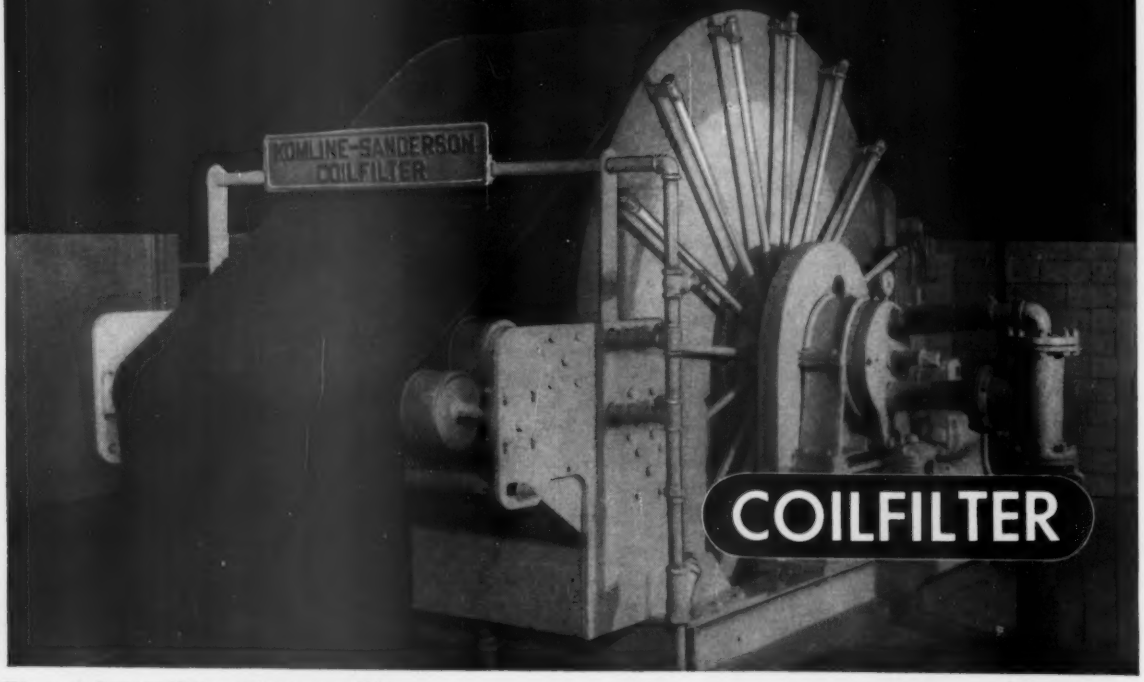
ECONOMICAL OPERATION Operating and fixed costs for a fresh solids dewatering installation are lower than for digestion and drying. Operational problems —and costs—are minimized by the elimination of dependency upon biological processes. Plant compactness requires less labor.

FREEDOM FROM NUISANCE With standard chemical conditioning, dewatered fresh sludge does not produce odor or other nuisance, and bacteriologically is amenable to standard methods of disposal. Absence of digesters precludes overloading.

This is the first of a series of advertisements describing the advantages of fresh solids dewatering on Coilfilters, only sludge vacuum filters successfully and consistently doing this job.

KOMLINE-SANDERSON ENGINEERING CORPORATION

PEAPACK, NEW JERSEY



Equipment News

CONTINUED FROM PAGE 19A

desired, the control loop can be closed to automatically monitor the steady-state control devices or otherwise regulate the process through "on-stream" continuous measurement.

AutoAnalyzer systems are available for single or multiple component determinations.

Aeration Waste and Sewage Ejectors

207

Penberthy Mfg. Co., Detroit, Mich., has developed an answer to the problem of discharging waste effluents into streams, sewers or lakes without danger of pollution. The solution: Penberthy aeration ejectors installed in activated sludge processes.

This system cuts by 95% the high concentration of bacteria cells and is said to provide an amazing 20 to 25% oxygen absorption compared to a 4 to 5% absorption by porous plate or mechanical systems at a saving of over 40% in horsepower.

Easily planned, properly balanced systems are simple to install and operate in new or present installations . . . offer a practical means of providing supplemental capacity to existing facilities. Cost of installation, maintenance and power are low.

Light Rotary Air Compressor

208

Le Roi Div., Westinghouse Air Brake Co., Milwaukee, Wis., has announced the lightest (2250) lbs) and slowest (1600 rpm) 125 cfm rotary portable air compressor on the market.

The new 125RG2 is a sliding vane type two stage compressor with an in-line cylinder arrangement. It is rated at 125 cfm of free air compressed to 100 psi.

The compressor is powered, by direct drive, with a Le Roi engine which is a wet sleeve overhead valve engine of proven design. A 100 per cent capacity modulating control matches air supply to air demand within a pressure range of 10 psi. "One-valve" air pressure adjustment is provided.

The engine-compressor is supported

CONTINUED ON PAGE 24A

ONLY FROM KUHNS

DUCTILE

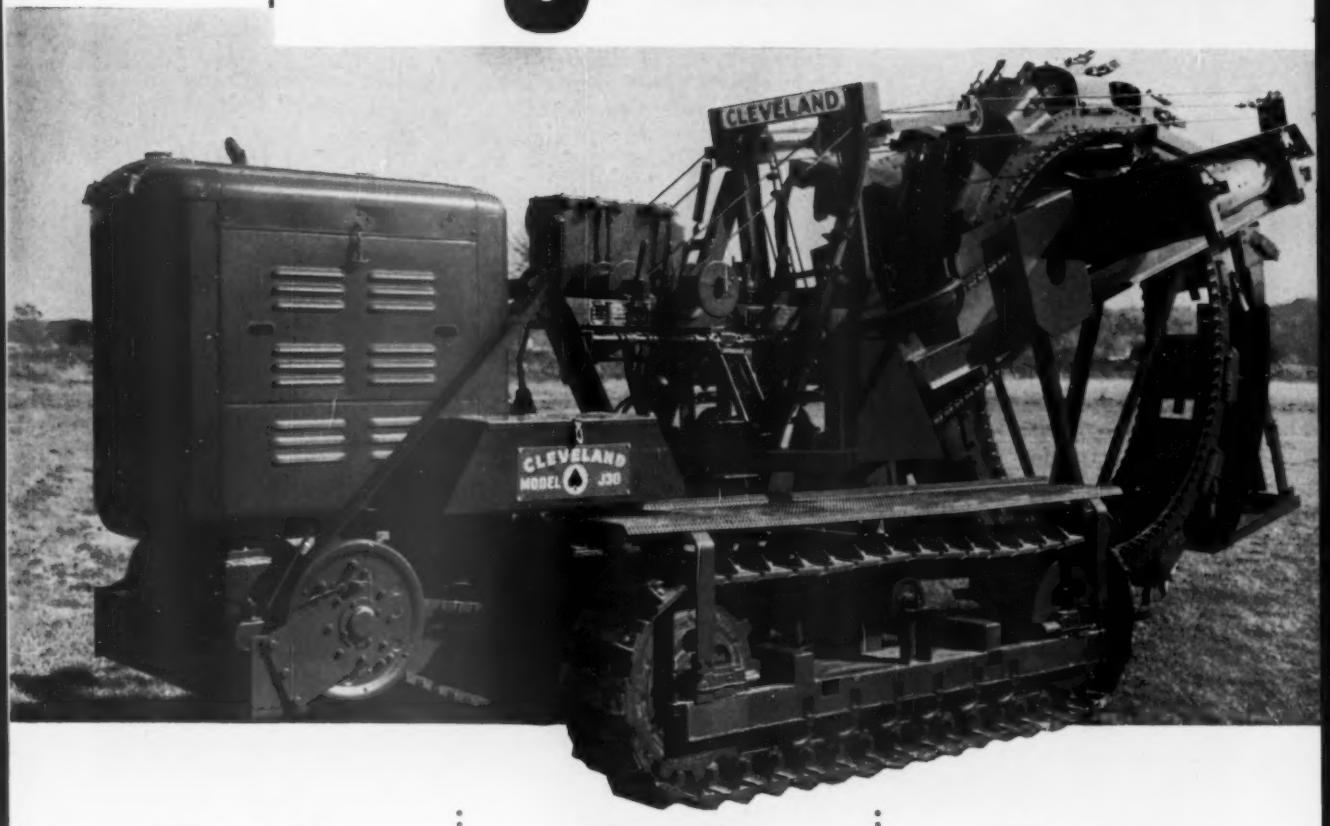
IRON PIPE FITTINGS

Kuhns long lasting ductile iron pipe fittings for high strength and corrosion resistance are pressure rated by Underwriters' Laboratories, Inc. Most types and sizes are stocked for prompt delivery, along with our complete line of high quality cast and malleable iron fittings. Write for catalog today.

THE KUHNS BROTHERS CO.
1800 McCall St. • Dayton, Ohio

OVER 3,000 SHAPES AND SIZES

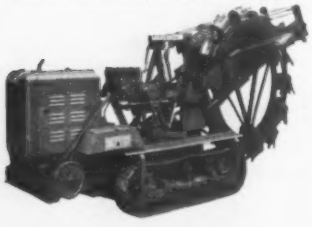
Announcing 3 GREAT NEW



The J-20

Width over crawlers ..... 4′ 10″
Crawler length, C.C. ..... 6′ 3″
Overall length .....21′ 6″
Width of crawler shoe ..... 10″
Weight ..... approx. 13,500 lbs.
Ground bearing pressure ..... 8.8 psi.
Cuts trench 13″ to 24″ wide, to 5′ 6″ deep

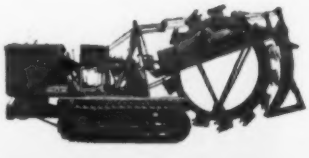
Principal applications:
urban areas, utilities lines, services, extensions, mains, house footings, etc.



The J-30

Width over crawlers ..... 6′
Crawler length, C.C. ..... 6′ 9″
Overall length .....22′
Width of crawler shoe ..... 14″
Weight ..... approx. 15,000 lbs.
Ground bearing pressure ..... 6.5 psi.
Cuts trench 13″ to 24″ wide, to 5′ 6″ deep

Principal applications:
suburban areas, drainage, utilities, gathering lines, footings, septic tanks, leach beds.



The J-40

Width over crawlers ..... 8′
Crawler length, C.C. ..... 7′ 6″
Overall length .....23′
Width of crawler shoe ..... 18″
Weight ..... approx. 18,800 lbs.
Ground bearing pressure ..... 5.6 psi.
Cuts trench 17½″ to 30″ wide, to 5′ 6″ deep

Principal applications: trench up to 30″ wide—pipelines, waterlines, drainage, irrigation, sewer lines, utilities.

...with the basic Cleveland characteristic... *Quality*

CLEVELAND TRENCHERS

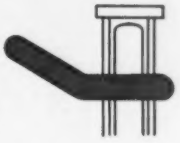
with ...revolutionary new V conveyor

...world's finest trencher crawlers

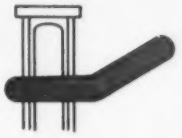
...all operations controlled at operator's seat

V CONVEYOR ... provides maximum clearance under digging wheel rims ...allows higher heaped loads without clogging ... provides constant elevating angle for faster, higher spoil discharge ... reduces rolling and tumbling ... has stronger torsion-free construction ... employs huskier, longer-lived bearings.

AUTOMATIC CONVEYOR SHIFT ... operator controls hydraulic shifting and positioning of conveyor ... digs past poles, trees, shrubs ... places spoil where needed ... *all* without leaving seat, without interrupting other operations.



DUAL INDEPENDENT CONVEYOR DRIVE ... identical, self-contained hydraulic motor and planetary gear drives in each head-pulley eliminate *all* conveyor chains and sprockets ... reduce belt slippage and wear ... furnish operator fingertip control of conveyor belt direction and speed (215-1,000 fpm) independent of all other operations.



FINEST CRAWLERS ON ANY TRENCHER ... employ double flanged wheels, rollers and sprockets with wide-spaced teeth ... drives on each end of 1½" dia. hardened pins ... completely eliminates pockets for dirt, stones, etc. ... eliminates take-up devices ... gives greater track stability ... lengthens wear life ... sprockets, wheels and idlers ride on sealed ball or roller bearings requiring only 200-hour lubrication ... a tremendously long-lived, trouble-free, easy-rolling crawler track.

BIG 16"x3" HYDRAULIC STEERING BRAKES ... controlled by suspended-type foot-pedals ... provide simple easy steering and maneuvering.

HYDRAULIC CRUMBING SHOE ... now, crumbing shoe advantages (cleaning, grading) are practical even in crowded digging ... Cleveland's hydraulic shoe control (optional, extra) pivots shoe back and up to allow setting wheel to required depth at walks, drives, underground obstructions, etc.

Engine, Hoist, Wheel, Shoe, Conveyor Speed—Direction—Shift, Crawlers

...Every Operation Controlled at Operator's Seat.

Good

The CLEVELAND TRENCHER Co.

Everywhere

Pioneers of the Modern Trencher

20100 St. Clair Avenue
Cleveland 17, Ohio

Economical, Trouble Free
COAGULATION
With
Ferri-Floc
FERRIC SULFATE

Ferri-Floc

Reduce your water treatment problems to a minimum with Ferri-Floc—the superior Coagulant — Ferri-Floc is a free flowing granular salt that can be fed through most standard dry feed equipment — It is easy to handle and can be stored in closed hoppers over long periods of time.

WATER TREATMENT

Efficient Coagulation of Surface or Well Water — Effective in lime-soda ash softening — Adaptable in treatment of all industrial applications.

SEWAGE TREATMENT

Coagulates over wide pH ranges and provides efficient operation regardless of rapid variations of raw sewage — Very effective for conditioning sludge prior to vacuum filtration or drying on beds.

COPPER SULFATE

COPPER SULFATE safely controls about 90% of microorganism normally encountered in water treatment plants efficiently and more economically than any other chemical.

SULFUR DIOXIDE SO_2

SULFUR DIOXIDE is used most effectively for dechlorination in water treatment and to remove objectionable odors remaining after purification.

FREE BOOKLET — Let us send you free a 38 page booklet that deals specifically with all phases of coagulation.

TC
TENNESSEE CORPORATION
TENNESSEE CORPORATION

Equipment News

CONTINUED FROM PAGE 21A

on a welded steel frame of unit construction and is enclosed in a lockable steel metal housing. Three-point suspension protects against towing distortion over rough terrain. The towing eye on the draw bar can be quickly replaced by a ball socket hitch when required. Length of the compressor is 10 ft 7 inches; width is 5 ft 4 inches, while height is 5.5 ft. Tool boxes are full length of housing, with no wheel-well interference.

Two Level Stages Available With One Magnetrol

209

Magnetrol Inc., Chicago, Ill., has developed four new top-mounting tandem displacement type Magnetrols that combine the functions of two separate controls with only one tank opening, provide two level stages — wide differential for control of two pumps or one pump and high or low alarm.

A feature of these controls is the ability to "change" switch actuation points by merely sliding the displacers up or down as desired. They lock securely to the Type 316 stainless steel stranded cable stem by means of Type 316 stainless steel cable clamps.

Large Adjustable Stroke Diaphragm Pump

210

Denver Equip. Co., Denver, Colo., has announced that their adjustable stroke diaphragm pump is now available in a full range of sizes, from 1 inch Simplex to 10 inch Duplex, capacities from 2½ to 1000 gpm.

A new, improved diaphragm which makes possible up to 75 per cent higher capacity has a patented spiral nylon cord construction. The exclusive curvature of diaphragm provides a true catenary curve flexing throughout the entire stroke thus avoiding destructive kinking. A heavy molded rim distributes tension to the entire circumference of the diaphragm and permits the diaphragm to be clamped in place. This eliminates bolt holes

CONTINUED ON PAGE 27A

Absolute Rigidity Means

...longer tool life

...perfect connections

Rigidity on the main . . .

Widely spread chain hook washers of the new B-100 are deeply recessed in yoke—cannot slip off when used on large diameter pipe. Unique design of chain hook keeps chain from twisting while tightening. They all add up to absolute rigidity on the main—machine cannot move during drilling, tapping or inserting operations. Broken tools and leaky connections are eliminated.

Rigidity in the boring bar . . .

Three widely spaced boring bar bearings, two in the feed sleeve and one at extreme bottom of boring bar, assure perfect boring bar alignment. Molded nylon lower bearing supports drill when it first contacts the main. Pipe curvature cannot deflect drill—tools give longer effective life. These three boring bar bearings guarantee perfect centering of tool and stop, assuring a pressure-tight connection.

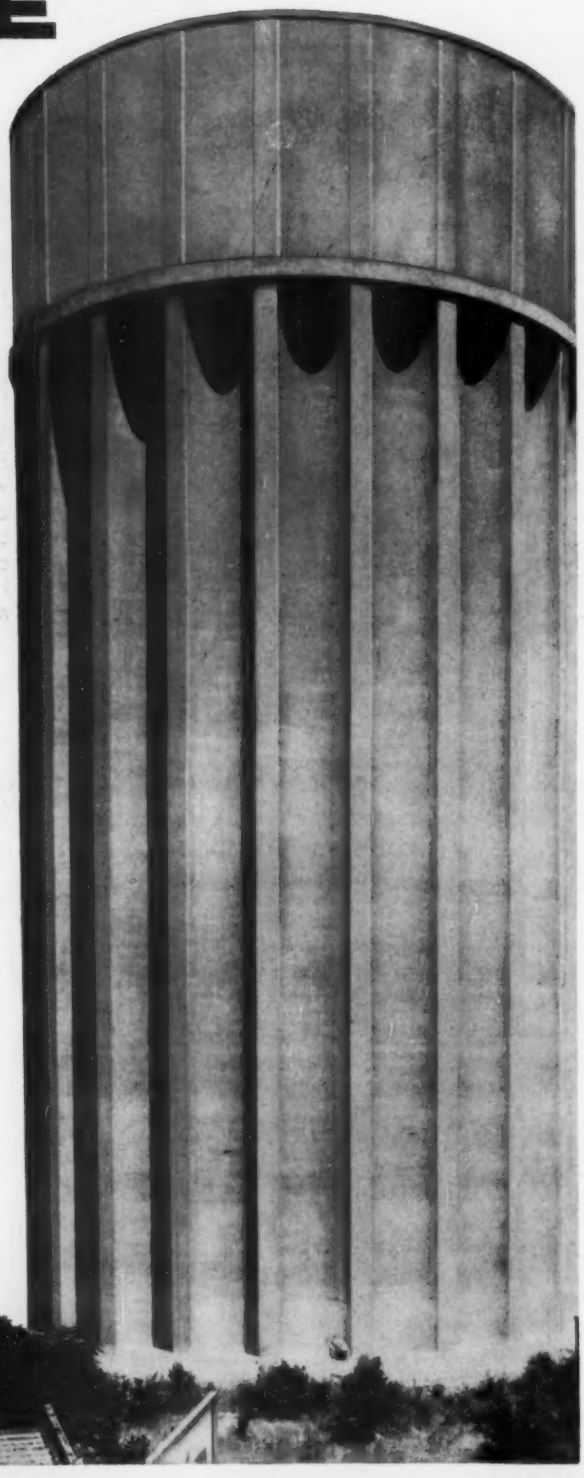
These are only a few of the many advanced features of the new Mueller B-100 Drilling, Tapping and Inserting Machine. They are typical, however, of the attention to detail in research, design and engineering that become a part of every Mueller product used by the water industry.

MUELLER®
B-100 Machine

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles
In Canada: Mueller, Limited, Sarnia, Ontario

MORE THAN 2,000 PRESTRESSED CONCRETE WATER TANKS IN SERVICE



In the development of residential and industrial water supply facilities today, no other type of tank offers so many advantages as does the Prestressed Concrete Tank. Modern in engineering and design, proven in service, lowest in cost... prestressed concrete should be considered in any tank planning.

Check these advantages:

- No maintenance required
- Owners never return to other types
- 75% of construction cost spent locally
- Lowest overall cost to community
- Longest service life of any tank

Send for Bulletin T-22

PRELOAD
TRADE MARK

THE PRELOAD COMPANY, INC.
211 East 37th Street
New York 16, New York

PRELOAD CONCRETE STRUCTURES INC.
837 Old Country Road
Westbury, Long Island, New York
Phone: EDgewood 3-4040

HERRICK IRON WORKS
28400 Clawiter Road
Hayward, California
Phone: Lucerne 1-4451

THE PRELOAD COMPANY, INC.
711 Perimeter Road
Kansas City, Missouri
Phone: Victor 2-5885

THE PRELOAD COMPANY, INC.
351 Jefferson
Dallas, Texas
Phone: WHitehall 1-5707

THE CANADA GUNITE COMPANY, LTD.
7325 Decarie Blvd.
Montreal 16, Canada

2,000,000 gallon tank, Tyler, Texas

Equipment News

CONTINUED FROM PAGE 24A

that would weaken the diaphragm.

The New Denver Diaphragm Pump is used for pumping filtrates, metering flotation feed or regulating thickener underflow. The new high capacities mean that it is now possible for one unit to do what previously required several smaller pumps.

Heavy Duty Steam Cleaner

211

Aeroil Products Co., Inc., South Hackensack, N. J., has announced the introduction of an all new CLS-400 Heavy Duty Steam Cleaner.

The new unit has a capacity of 400 gal per hour at pressures up to 150 psi. The burner is of the downdraft type and will burn either fuel oil or kerosene.

A low water cut-off is furnished to protect the coils in the event of water failure. The heating coils are the drum type to permit complete drainage and feature a built in de-sooter arrangement.

The compound tank has a three to six hour capacity, depending on the degree of concentration. The compound is heated and agitated automatically and no pre-mixing is required.

The steam gun is the full swivel type. Two gun operation is available.

Flexible Plastic Pipe, Eliminates Stress Cracking

212

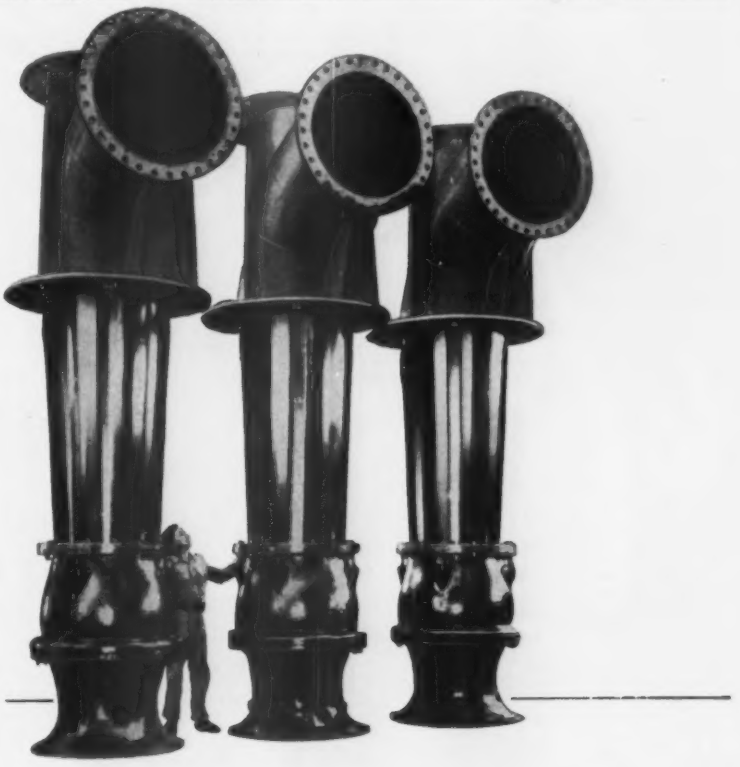
Carlon Products Corp., Cleveland, Ohio, has developed a new flexible polyethylene pipe that is said to defy stress cracking and offer superiority in all of the other features of previously available flexible plastic pipes. Called Carlon Hi-Mol, the pipe is made from virgin polyethylene of a unique molecular structure which requires a new method of extrusion by machines of special design.

Year-long laboratory and field installation tests have proved the pipe's ability to withstand extended periods of operation at higher than rated pressures in handling corrosive liquids with no stress cracking. Razorlike slits and pinholes are prevented by the molecular structure and high molecular weight of the material — one million molecules in a chain compared to the average polyethylene's 27,000. This structure also provides superior strength in withstanding pressure surges, torque stresses and higher operating temperatures. The new Hi-Mol pipe has a superior resistance to chemical corrosion, abrasion, and deterioration from sunlight and sub-zero temperatures.

Vapor Vent For Underground Tanks

213

OPW-Jordan, Cincinnati, Ohio, has developed a new OPW-Jordan No. 23 Vapor Vent that eliminates the hazards of combustible vapor accumulating at ground level. The vent directs escaping vapors upward and allows storage tanks to breathe more freely increasing the efficiency of tight fill service. Non-corrosive aluminum body with 40 mesh brass screen provides long durable life.



the bigger your pumping problems . . . the better your reasons for giving them to

WHEELER-ECONOMY

You know how big problems can be, in selecting pumps for water works reservoir service. The Pumps you see here are specially designed and built to solve such problems. They're 36" Axial Flow Wheeler-Economy Pumps, each of which delivers 28,000 gpm. And they've been in continuous service for many years with only routine maintenance and modest operating costs.

If you're puzzled over which pumps to use for water works, municipal or industrial power plant service, drainage, irrigation or flood control, see C. H. Wheeler. Your representative can help you even if you need capacities exceeding 220,000 gpm and heads of 75 feet. He'll give you expert advice on pump design and construction, and station arrangement suggestions you'll find helpful.

Economy Pump Division

C. H. WHEELER MFG. CO.

19th and Lehigh Avenue • Philadelphia 32, Pa.

Whenever you see the name C. H. Wheeler on a product, you know it's a quality product

Centrifugal, Axial and Mixed Flow Pumps • Steam Condensers • Steam Jet Vacuum Equipment • Marine Auxiliary Machinery • Nuclear Products

WHEN WATER MEANT DRUDGERY! The water our ancestors used was as difficult to come by as it was doubtful in quality.

TODAY'S HOUSEKEEPER, served by a modern American water system, finds the water she needs—clean pure water—at her fingertips.

U.S. cast iron **PIPE**

FOR WATER, SEWERAGE AND
U. S. PIPE AND FOUNDRY COMPANY

but better than ever today!

Modern technology plus mine-to-line control insures top quality of U.S. Cast Iron Pipe

Our water today is made so universally pure and wholesome no American ever doubts its quality.

This is a tribute to the forward-looking water officials who plan and administer the nation's water systems... and their suppliers.

For example, U. S. Pipe controls every step from mining to shipping ... uses every possible quality check to make sure its product measures up to the heavy responsibility placed on it.

This close and painstaking supervision insures the unvarying high quality and dependability of U. S. Pipe—both indispensable to a product that plays so big a part in protecting the nation's health.

GOOD PIPE BEGINS HERE... At one of U. S. Pipe's mines near Birmingham, where high grade coking coal, essential to quality, is mined.

PIPE TAKES SHAPE... Molten iron in this rapidly rotating mold assumes its form as pipe—one of many manufacturing steps.

TESTING STRENGTH... Pipe specimens are periodically subjected to more brutal treatment in laboratory than they will receive in normal service.

INDUSTRIAL SERVICE CAST IRON

Birmingham 2, Ala. *A wholly integrated producer from mines and blast furnaces to finished pipe.*

New! BADGER Read-o-Matic* REGISTER

adds speed-reading to water metering

Here is the industry's first practical outdoor register — the Badger Read-o-Matic. Now meter reading routes can be completed in half the time — with no more wasted calls. Plus other important benefits such as:

• *No more "lockouts"* • *No more in-house accidents* • *No more access problems* • *No more inconvenienced customers*

The new Badger Read-o-Matic means a modern meter reading system that your water department can have now — and opens a whole new realm of possibilities for the future. You'll want to read about them in our free new Badger Read-o-Matic folder.

*Pat. applied for in U. S. A. and foreign countries

Badger Meter Mfg. Co. • 4545 W. Brown Deer Rd. • Milwaukee 18, Wis.

News of Suppliers

Dorr-Oliver Transfers Filtration Engineering To East Coast

Dorr-Oliver Inc., Stamford, Conn., has announced the transfer of its filtration engineering and development operations from Oakland, California to Stamford, Connecticut. Part of a long-range plan for centralization of all filtration engineering and manufacture in the east, the move will provide better service to customers through improved engineering and production communication. Manufacture of Dorr-Oliver filtration equipment is already centered at the company's substantially expanded Hazleton, Pennsylvania plant, close by the new Stamford International headquarters where the majority of Dorr-Oliver engineering and development operations are located.

Dorr-Oliver's filtration engineering and development activities have been located in Oakland since the formation of the Oliver Continuous Filter Company in 1910. The company's Oakland facility will continue as centralized location for engineering and manufacture of semi-mass produced equipment such as cyclone classifiers, centrifuges and pumps.

Graver Tank Opens South American Office

The International Division of Graver Tank & Mfg. Co., Inc., Chicago, Ill., has established an office in Caracas, Venezuela.

William I. Woodson has been appointed general manager of Venezuelan operations. The new South American office will enable Graver to offer its complete line of equipment, including large floating roof tanks, for sale and erection in Venezuela.

Woodson, a long-time resident in Venezuela, formerly served as manager of the Venezuelan Division of Texas Petroleum Company and also in Turkey as petroleum advisor to the Turkish government. He formerly resided in San Marcos, Texas.

Erwin C. Barnes, a Graver field engineer with wide overseas experience, also was named as Woodson's assistant.

S. Morgan Smith Acquired by Allis-Chalmers

Beauchamp E. Smith, president of S. Morgan Smith, York, Pa., has announced the S. Morgan Smith Board of Directors has approved a plan whereby Allis-Chalmers Manufacturing Co., Milwaukee, Wisconsin, would acquire the assets of the Smith Company in exchange for Allis-Chalmers common stock.

Smith stated that the basis of exchange will be 1.1 shares of Allis-Chalmers common for each share of S. Morgan Smith capital stock outstanding. He advised that it is the intention of the two firms to conclude the transaction as soon as possible.

Robert S. Steveson, president of Allis-Chalmers said, "we are very happy that the directors of S. Morgan Smith have approved this transaction. In the event the transaction is completed it would be our intention that the present management of S. Morgan Smith would of course continue to operate the York plant, and that the

business go on as it has in the past. We would hope that Allis-Chalmers' scope and breadth would help contribute to the growth of the York enterprise."

Hagan Opens New Headquarters

Hagan Chemicals & Controls, Inc., has announced that the company's new headquarters building and research center are now situated on 27 acres of former farm land along the Penn-Lincoln Parkway West, 12 miles from Downtown Pittsburgh.

Built of brick and marble-like decorative panels, the rambling two-story structures are both functional and beautiful. Giant cut stone pillars and floor to ceiling glass doors and windows at the main entrance area form the focal point of design.

The main building, an L-shaped structure containing 60,000 sq ft of floor space, houses the executive offices, sales division offices and the purchasing, engineering design, accounting and advertising departments.

The adjacent 33,000-square foot Research Center, connected to the main office building by an enclosed corridor, houses all laboratory facilities and chemical research groups, as well as the scientific library and a 200-seat cafeteria.

Months of study by officials of Hagan and Shaw-Walker Company, Pittsburgh, resulted in departments being located to permit the most efficient work flow.

Both buildings have area-controlled air conditioning, complete with an electro-static air filter. Acoustical Fiberglass ceiling panels hold noise to a minimum. Work areas have vinyl tile flooring. Pastel colors enliven the walls and harmonize with the pleasant decor throughout the building.

The reception area has wood panelled walls and a slate floor. All executive offices are panelled and carpeted.

Lawlor Retires From General Filter

General Filter Co., Ames, Ohio, has announced that Mr. J. P. Lawlor, President, has retired. Mr. Lawlor founded the company in 1935 and held the office of President until his retirement. Mr. & Mrs. Lawlor will spend the winter of 1958-59 touring South America.

Mr. Merlin H. Anderson succeeds Mr. Lawlor as President. The other officers are: Mr. Vincent M. Roach, Vice President, and Mr. Forrest R. Kenny, Secretary-Treasurer.

B-I-F Opens Baton Rouge Office

B-I-F Industries Inc., Providence, R. I., has opened a new regional sales office at 256 Peachtree Boulevard at Florida Street in Baton Rouge, Louisiana.

The new office will be headed by Mr. Lewis H. Johnson, Jr. and will handle the products of B-I-F Industries and its three divisions: Builders-Providence Inc., Proportioneers Inc., and Omega Machine Co.

Here's the big news behind the industry's first practical outdoor register

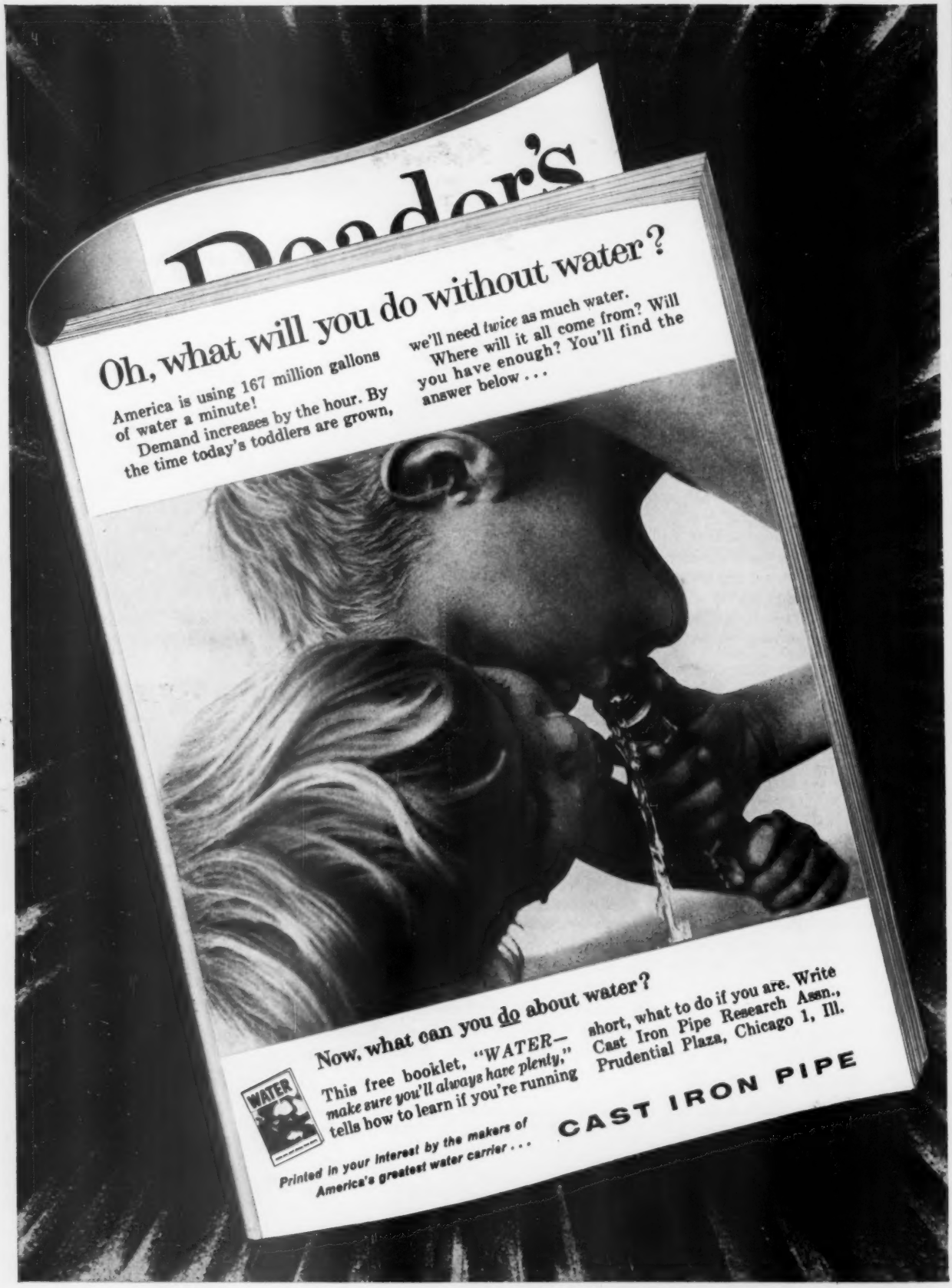
The Badger Read-o-Matic is powered entirely by the meter to which it is attached . . . works on an exclusive "pulse" principle. As water flows through the meter, the generator sends a pulse by wire to the Badger Read-o-Matic register outside for accurate recording.

Like our Badger meters, the Badger Read-o-Matic is precision-engineered — thoroughly tested by our trained water meter experts in the laboratory and in the field. Badger Meter products are the result of over 50 years of *specialized* water meter experience — products that excel around the world in accuracy, durability, dependability and low maintenance cost.

Send for free, colorful brochure that tells you all about the revolutionary Badger Read-o-Matic. For an actual demonstration, see your Badger representative or write us direct.

Badger Water Meters

Badger Meter Mfg. Co. • 4545 W. Brown Deer Rd. • Milwaukee 18, Wis.


Reader's
Oh, what will you do without water?
America is using 167 million gallons of water a minute!
Demand increases by the hour. By the time today's toddlers are grown, we'll need twice as much water.
Where will it all come from? Will you have enough? You'll find the answer below . . .
Now, what can you do about water?
This free booklet, "WATER—make sure you'll always have plenty," tells how to learn if you're running short, what to do if you are. Write Cast Iron Pipe Research Assn., Prudential Plaza, Chicago 1, Ill.
WATER
Printed in your interest by the makers of America's greatest water carrier . . .
CAST IRON PIPE

New Ad Campaign in Reader's Digest Dramatizes America's Water Problem

Cast Iron Pipe Research Association promotes better understanding of water supply and distribution problems

Offers Informative Booklet for Step-by-Step Action at the Local Level

Here's help for you and everyone else directly concerned with the supply, treatment and distribution of water—help that will acquaint the people in your town with the vital importance of this growing problem.

On the opposite page you see the first in a series of advertisements, this one appearing in February *Reader's Digest*. Placed by the Cast Iron Pipe Research Association, these striking advertisements point out to Mr. and Mrs. America how much we depend on a good water system and why we can no longer take it for granted.

Similar advertising will appear regularly this year in *U. S. News & World Report*, *Nation's Business*, *Better Homes & Gardens*, *American Home* and *Sunset* magazines to carry this public service message to millions of community leaders and homeowners.

Free Local Plan-of-Action Booklet

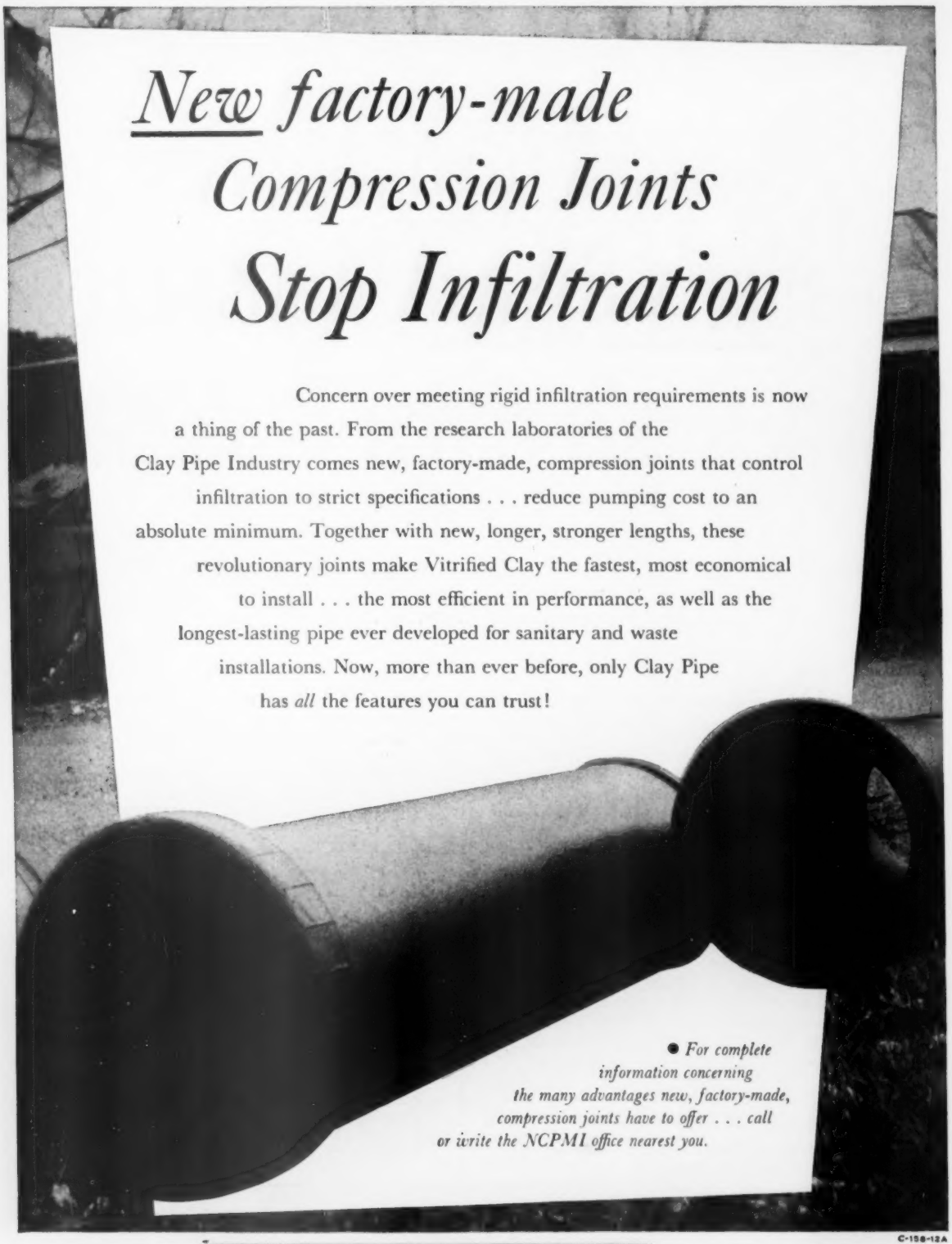
These ads offer a free booklet telling about the water problem. It shows how responsible citizens can acquaint themselves with the needs of their community. It also gives a step-by-step outline of action, telling how they can help their officials extend and improve the local water system through more adequate rate structures or financing.

We'll be happy to send you a free copy of this new booklet. Write to Thos. F. Wolfe, Managing Director, Cast Iron Pipe Research Association, 3440 Prudential Plaza, Chicago 1, Ill.

THREE REASONS WHY CAST IRON PIPE IS *AMERICA'S GREATEST WATER CARRIER:*

1. More miles of underground cast iron water mains are now in use than of all other kinds of pipe combined.
2. More miles of cast iron water mains are now being purchased and laid than of any other kind of pipe.
3. Impartial surveys prove that today's water utility officials and consulting engineers prefer cast iron pipe for underground water distribution by an overwhelming majority.

CAST IRON PIPE



New factory-made Compression Joints Stop Infiltration

Concern over meeting rigid infiltration requirements is now a thing of the past. From the research laboratories of the Clay Pipe Industry comes new, factory-made, compression joints that control infiltration to strict specifications . . . reduce pumping cost to an absolute minimum. Together with new, longer, stronger lengths, these revolutionary joints make Vitrified Clay the fastest, most economical to install . . . the most efficient in performance, as well as the longest-lasting pipe ever developed for sanitary and waste installations. Now, more than ever before, only Clay Pipe has *all* the features you can trust!

● *For complete information concerning the many advantages new, factory-made, compression joints have to offer . . . call or write the NCPMI office nearest you.*

C-158-12A

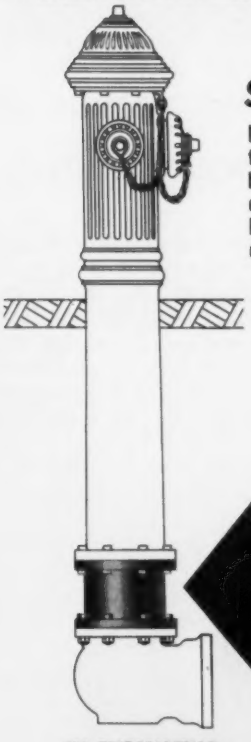
Vitrified **CLAY PIPE** *Never Wears Out*

NATIONAL CLAY PIPE MANUFACTURERS, INC. 1820 N Street, N. W., Washington 6, D.C.
311 High Long Bldg., 5 E. Long St., Columbus 15, Ohio • 703 Ninth & Hill Bldg., Los Angeles 15, California • Box 172, Barrington, Illinois • 1401 Peachtree St., N. E., Atlanta 9, Georgia

Grade changes caused this.

HERE IS HOW SMITH HYDRANTS CAN BE EXTENDED

If existing Fire Hydrant Nozzles and Caps are not readily accessible due to grade changes this condition can be quickly and economically corrected by installing Hydrant Standpipe Extensions as illustrated. The installation of the Extension will provide clearance between the groundline and the Hydrant Nozzles permitting the free rotation of the wrench and the quick coupling of fire hose to existing Hydrants.



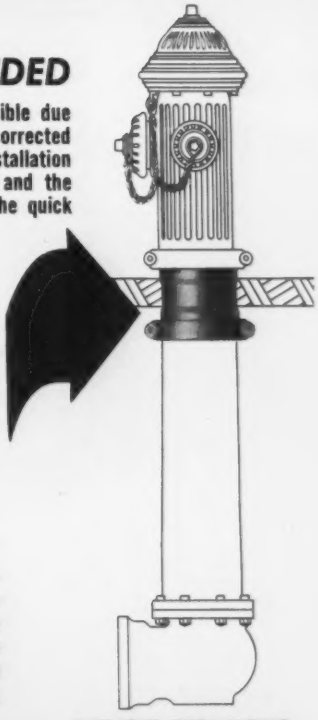
BY EXCAVATING

PROTECTOP HYDRANT

Depth of bury can be increased by installing Standpipe and Main Valve Rod Extensions at the groundline between the Upper and Lower Sections. This construction permits installation of the Extension without excavating and the reuse of the original Hydrant internal operating parts. The Extensions are produced in 6″ increments.

ONE PIECE STANDPIPE OR TWO PART HYDRANT

After the Standpipe is excavated the extension is installed between the bottom of the Standpipe and the Hydrant Elbow. The depth of bury is increased by the desired amount reusing the original operating parts. The Extension thread accepts the original Main Valve Rod assembly. The Extensions are produced in 6″ increments.



WITHOUT EXCAVATING

FIRE HYDRANTS · VALVES · SINCE 1896

THE A.P. SMITH MFG. CO.

EAST ORANGE, NEW JERSEY

More than five miles of extra heavy galvanized Wrought Iron Pipe, from 1½-inch to 3½-inch, were used in the construction of the Treasure Island, Florida, Sewage Collection Plant.

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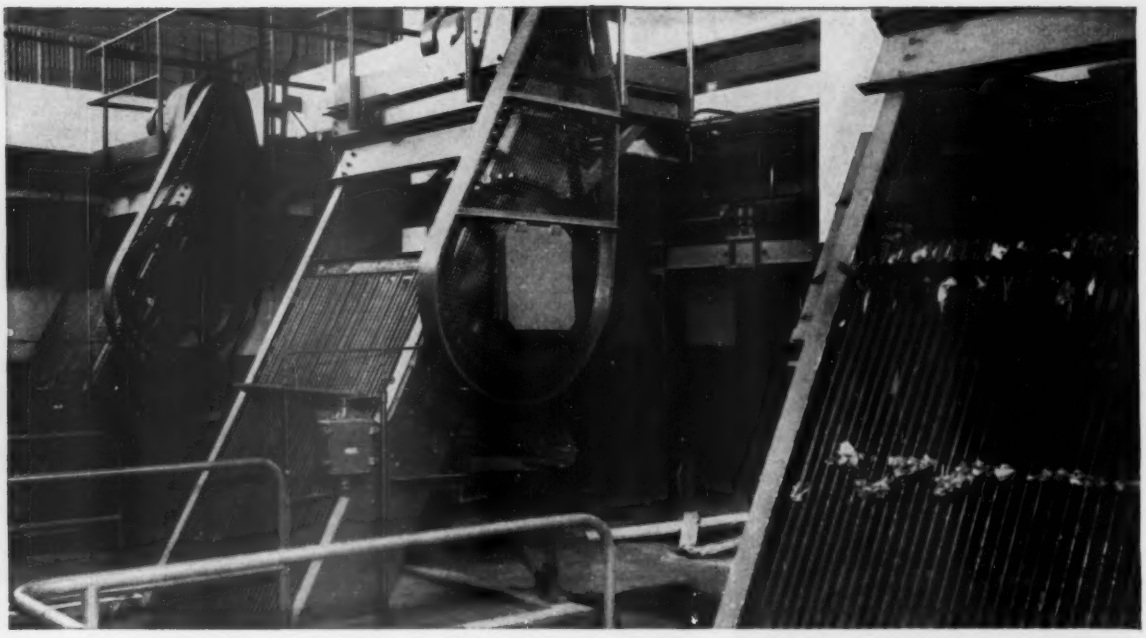

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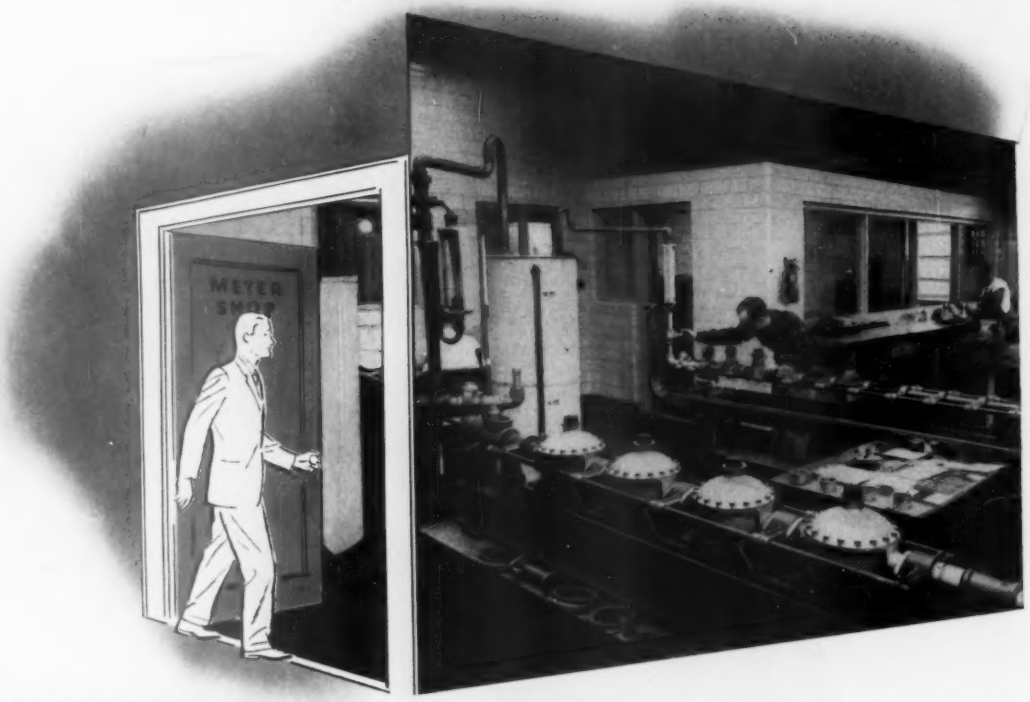

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WATER & SEWAGE WORKS

Increased water use for irrigation, industry, and per capita, plus a dry weather cycle, intensifies the ageless conflict over water priorities, thus demanding the utmost concern for public interest in the . . .

Regulation of Water Resources

by DR. ABEL WOLMAN, Professor of Sanitary Engineering, The Johns Hopkins University, Baltimore, Maryland.

RESUME: Dr. Wolman, in this paper which was presented before the Pennsylvania Water Works Association, discusses some of the basic reasons behind the need for constant awareness by everyone where legislation pertaining to water resources is being considered.

He presents cases where hastily conceived legislation, usually passed during periods of stress, have created situations that would override many years of previous court decisions and statuatory provisions, if adhered to in their present form.

■ THE CONTENTION between public and private groups for water is a familiar one over thousands of years. It is part of the endless adventure of finding a painless way of governing people so that they are not at each other's throats perpetually. It is a history of a struggle between complete freedom of individual action and the form of organization which has for its purpose the partial restraint of freedom of individual action for the general good.

Why so much talk in recent years about competitive water use? What is it that has dramatized this, in say the last decade?

There are, of course, the obvious increases in water use by all of the divisions of our society, including the increasing use of water for irrigation. If the total quantities of water from year to year had remained stable, it would have been difficult enough. But the difficulty has been stimulated and compounded, by the fact that the last five years were in the period of a dry cycle. If western experience with irrigation is any cue, some of the heat generated by the use of water for irrigation is likely to be dissipated if it rains heavily over the next five years. There are irrigation projects in the West which have gone into complete disuse when a dry period ended, because they did not turn out to be as permanently useful and profitable as they were expected to be.

Even if there were no irrigation, more water is needed. Today, there are wider uses for all kinds of water. Obviously, all of the best and cheapest sources have been pre-empted which is a tribute to engineering proficiency and common sense. Naturally, those sources that were nearest, least costly, and most valuable were chosen. Therefore, as we move into an era when it is going to cost us more because we are going to go greater distances to get water.

Changes Cause Friction

This is a time of transition, from an era when water could be had for the taking, to an era in which there isn't enough cheap water to go round. Like every other time of transition, it is essentially a period of friction. Transition and friction are twins, and it does not make much difference in which area of human affairs the transition occurs. It could be water, it could be land, it could be politics, it could be structure of government. Whenever there is a necessity for a major change, there is bound to be friction.

It should be pointed out that the dry years are not the period in which to write profound, thoughtful, corrective legislation. A period of stress is a difficult time to write the right kind of legislation, because history shows it is invariably wrong. Legislation is too sensitive in the period of stress to the causes of stress.

It is true that only in periods of stress is there enough interest in legislation to get it enacted. That fact, however, also holds a warning. Stress and strain are not the best ingredients of sound legislative practice.

Humid States No Longer Humid

As the demand for water increases, several of the so-called humid states are really no longer humid states.

They are the dry humid states. In virtually all the humid states, we have periods of dryness, both over long cycles and also in every year. The newspapers are always excited about the repetition of this annual dryness as if it had never occurred before. In North Carolina, South Carolina, Alabama, Georgia and the like, streams have always dried up in the summertime. They are dry States in the summertime, and that creates a regularly-recurring difficulty.

There is one unpalatable truth in relation to the hydrologic cycle which no one likes to accept—particularly a statesman. He dos not want to be too bothered with this simple truth. The truth is that in any given situation, there isn't any more water than there is.

No Congressman wants to be dislodged from the idea that, if you have sufficient technology, sufficient legislative statutes, you could have more withdrawals in a semi-arid state than the equivalent of its ten to twelve inches of annual rainfall. It is an unpalatable truth to keep reminding him that is not only improbable, but impossible.

It is true that given a need, and at a price, one could supply Death Valley with water. The reason one does not bring water into Death Valley is that there is no particular pressing need which makes it desirable to do so at this time at the cost that would be involved. Tomorrow morning that need might appear. But for the moment, Death Valley is an area in which there just does not happen to be water. That unpalatable truth the residents of Death Valley, if there are such, must always take into account for normal development purposes.

Legislation Cannot Produce Water

Today, our society is too much impressed with the belief than problems can be solved by legislation. The idea is prevalent that if you have a problem in society, of which this is a pressing one, the answer is to rush to the State Capital and put something into the mill. Very often there is an impression it does not make much difference what that something is, provided it is on the right side of the proverbial fence, is properly prepared, is properly titled, and incidentally, properly passed.

A statute does not actually produce water. Legislative action has tremendous powers and capacities for changing society. However, there is no statute which creates water, although there are many statutes which provide the policies and the programs under which the supervision of water actually available is established, or imroved, or strengthened.

Water Regulation Programs

What, then, are the essential elements of a water regulation program for a State, insofar as history has taught it to us? They can be broken down as follows:

Number one seems quite fundamental, particularly as society becomes more complex. It is the assumption by the State of a responsibility in the water area. This does not mean a mere declaration in written form, but rather that the State does assume jurisdiction over water use and development. The degree of that jurisdiction should not be spelled out in the statute. The principle should be. It can be done very simply perhaps even in a paragraph.

It would give the State agencies the right to scrutinize water use, to determine to whom it shall go, and at what time, and the conditions under which water allocations should be made.

A second principle, is that once the State has assumed that kind of jurisdiction, it should undertake the collection, and more important, the interpretation, of water data. It should not replace the responsibility both of public and of private subdivisions, but the State should take the overlying responsibility for the orderly performance of this function.

The third principle—and here most States have so far fallen down—is that the State should determine and assess the availability of water throughout the State, whether surface or underground. When most States have fallen down, it is either through lack of budget, lack of personnel, or even lack of imagination.

The answer to the questions as to where is the water, and how much water is there, and what is its general natural behavior, should be a matter of state record. But mere gathering of information is not enough. As Will Rogers once commented, the mere collection of data is not an accomplishment, because, as he pointed out, "Collecting data is like collecting garbage. After you have it, you have to do something with it."

The next principle of State regulation is the development of a plan for the expected use of water in the future. People will tell you, of course, that is full of dynamite, and it is.

The State agency which tries its hand at this should not "play God" because "playing God" in this field is bound to lead to downfall.

Within a short history, one could say within ten years even, plans for expected use have had to be discarded. Not because they lacked the thoughtfulness of the technologist, but because the technologist could not have a pre-vision which was much beyond ten years.

That does not mean that you do not pre-empt some of the future. But you do it with a kind of feeling at night that "maybe I'm not quite as all-wise as I was during my office hours." That ingredient of restraint would be important for any State official group.

The next logical function of the State is to plan for the means of development to meet the expected future use. No plan for use is of much value until you can develop the technology for executing it.

One of the greatest deficiencies which humid-State statutes are pretending to remedy is in plans of development. But satisfactory plans cannot be spelled out in the statutes. What do you do about streams that dry up in the summer, but have ample flood flows, that have possibilities, that could have increased use? Any statute that attempts to spell that out is a straight-jacket which tends to prevent sound solution.

Water Vs. People

Finally, a good system of State water supervision will require the administrator to examine what he does in the light of its social and economic consequences. Included in that last very serious issue is the point as to who should pay for what he gets. This relationship between who benefits from water improvement and who pays for it is fuzzy. In the last twenty years, it has gotten fuzzier under the assumption, which seems international in character, that if you can get some remote central government to pay for development of water, you can be quite pleased because you have not paid for it.

It is an extraordinary universal fallacy that central government, whether federal, whether state, whether local, somehow or other creates money which does not come out of our pockets. The fallacy is clear to those in the water field, but it has to be impressed on the public mind, and particularly on the mind of the new user of water, the irrigator. The irrigator has the impression that all he must do is to get a statute which gives him not the number one priority, because nobody yet, including the irrigator, has been willing to run counter to Sam Baxter's claim that the domestic water user has the first priority, but number two priority.

He insists that he ought to come second. The implications of his claim, hydrologically and financially, are just beginning to appear on the horizon.

The final considerations in the whole field of water use are not technologic. They are problems of water versus people. The economics, the social values and the contests between people over water have gone on for a long time.

Case Histories Illustrate the Problem

Recent case histories of the humid States illustrate what has happened in the way of legislation and legislative recommendations.

These States have made a large number of studies in the last two years or so. An interesting and important lesson comes out of these last two to four years of studies. In the earliest studies, every one of the States with minor exceptions, recommended legislative action for immediate shift from riparian rights to prior appropriation. Such a recommendation documents the shallowness of inquiry, because the minute the inquiry becomes deep, nobody would suggest that immediate shift.

Subsequent studies by the same States have shown a complete change from certainty to uncertainty. New commissions for study increasingly cautioned against immediate legislation, particularly against any immediate legislation which would move from the one principle to the other.

Of the whole group of humid States, one State passed statutes enacting the shift. It will pobably have to unshift it, as the statute comes into application because it overrides previous court decisions, all statutory precedents over the previous 150 years. And if it persists, one cannot conceive of a more confusing water situation in the future.

Arkansas, North Carolina and Tennessee earlier recommended the shift to the appropriation doctrine. None adopted the recommendations and they are now taking a different slant.

Virginia recommended, in place of such a change, new capture and impoundment policies for the future. Oklahoma recommended, and this also is a sign of the times, that it have a statewide authority with policing power in order to develop impoundment facilities.

Texas recommended that the State underwrite the cost of certain water supply facilities. The reason is that it has gone through the worst periods of drought all through their history. Where do you turn in those droughts? Naturally to the State!

Tentative Model Water Law

The Michigan Tentative Model Water Law, suggested in 1957, is short and extremely interesting. Brevity is a good characteristic in statutes.

The Michigan statute is very brief because it sticks entirely to primary principles. It does not allocate priorities. It does not even suggest the order of priorities. It does allocate to responsible State agencies the power to allocate.

The Author's Observations

I take some pride in the fact that, although it is a little longer than the act which we drew up in my own State of Maryland in 1933, and which has served us well throughout the period since then, the Michigan Tentative Model Water Law provides many of the same principles as the Maryland Act.

For ten years I was the chairman of the regulatory agency in my own State that worked under the 1933 Act. Our difficulties were minimal. The only omission, and it was an omission forced upon us by the Legislature, was that agricultural uses other than for domestic livestock was deliberately eliminated from the jurisdiction of the agency. We are just as deliberately going back to the Legislature to re-insert it, for reasons with which you are already familiar.

With that minor re-insertion, and the Act is less than five pages long, it can function very well with us, because it depends, in its execution, upon the logic, the wisdom, the restraint of the administrative agency.

I know of no substitute for that, an administrative agency is the only mobile way of meeting a situation which is bound to be mobile. The future cannot be pre-empted. It cannot be frozen. We cannot say that one section of a State shall be developed and the other section shall be left permanently undeveloped, because time will change it. Time and the general attitude of the people.

Submersible Pumps Solve Residential Water Problem

Owensboro, Kentucky, whose main water supply comes from wells drilled in residential areas, recently installed six submersible pump-motor units to protect its residents from unsightly pumphouse buildings, as well as noise and vibrations that normally accompany the use of surface pumps.

The pumps are housed in understreet pump units, easily accessible through ordinary manhole covers. Well seals make the units flood, weather and vandal proof.

Starters and automatic control systems are mounted on adjacent telephone poles. The pumps are controlled by means of telephone wires from a remote panel located in the Owensboro Municipal Utilities Building.

Since the pump installations lie under city streets, no pump houses or other elevated structures take up valuable space or mar the appearance of the residential areas. And, the sealed pump units insure that the units are entirely silent and vibrationless in operation.

History tells of many crises caused by the lack of . . .

Planning Water Supply Resources *to meet expansion*

by JOHN E. KIKER, JR.,
Prof. of Civil Engineering,
University of Florida

EDITOR'S NOTE: In 1954, President Eisenhower expressed his conviction that "before very long America will almost unanimously look upon water as its single greatest resource." The public looks upon water in this light only, as Benjamin Franklin said, "When the well is dry, then we know the worth of water."

In this article the author has reviewed the planning of water supply resources in the State of Florida and used the experiences of the city of New York to illustrate results from improper water supply planning.

This information was presented in a paper given at the Civil Engineering Conference on Metropolitan Planning held at the University of Florida.

■ THE ENTIRE COUNTRY was made aware of the importance of water when New York City was threatened with a serious water shortage. In 1950, "Shaveless Thursdays" came into being as a means of dramatizing the predicament of the city, and penalties were imposed for the unauthorized use of water.[1]

In some respects the situation that occurred in New York illustrates the kind of thing to guard against in the planning and development of water supply resources. The reason for selecting New York City in this case as an example of what not to do, is because it might be the last place where you would expect a shortage to occur. Furthermore, its water history has been a series of crises, with new sources coming into operation just as consumption caught up with and passed the supply.[2] Some Florida cities and metropolitan areas have had similar experiences.[3] Although New York City has had good engineering advice, the reports and warnings of its engineers were not headed until it was too late to forestall the impending shortage. Construction of the Delaware Aqueduct did not start until 1937, although it was recommended in 1927 and reports on it were published in that year.[4]

The New York Experience

The plan for developing the new supply was not approved by the City Board of Estimate and the State Water Power and Control Commission until 1929. The development was further delayed by litigation when the State of New Jersey applied to the Supreme Court of the United States to enjoin the State and City of New York from diverting any of the waters of the Delaware or its tributaries. The Supreme Court decision permitting the City to divert up to 440 mgd was given on May 25, 1931. By that time the country was having a serious depression. This was considered the reason for a delay of about seven years, according to a report of an Engineering Panel on Water Supply under the chairmanship of Dr. Thorndike Saville.[5]

In any case, work which finally began on the project in 1937 had to cease in 1943 because of the impact of World War II and the shortage of men and materials. It did not resume until 1946, making a total delay of some 14 years. The water shortage of 1950 was caused by a drought in 1949. Under ordinary circumstances, the project should have been completed about eight years before the shortage occurred. Since 1950, numerous water shortages have occurred throughout the nation.

Interest in Florida

In 1953, the New York story was referred to in an editorial prompted by a relatively minor accident in the

"The public's tendency to consider the tap the source and to think no further, is a dangerous one."

state of Georgia. The editorial appeared in the *Florida Times Union*, under the caption "It's Too Late When the Tap Runs Dry." It explains the situation so well that it is worth repeating.[6]

"Water flowing from the tap has become such a dependable service that most of us now regard it as one of the absolutes. Because of this assumption, the rare failures in the service cause enormous difficulties and hasty adjustments to new conditions.

"Latest to be reminded of this were 400,000 of the residents of Atlanta, who were without water for a half hour when their main supply artery broke. Failure of electric services, gas lines, or heating systems can cause great discomfort and inconvenience, but failure of a water supply can make a city uninhabitable. Of all services and products supplied by utilities, water is the single one absolutely necessary to life."

The absolute necessity of water to life and the dire consequences of depending upon remotely located surface supplies that could not be protected properly was demonstrated by the Japanese early in 1942 when they took Hong Kong and Singapore after first rendering these cities helpless by cutting off their sources of water.[7] To continue with the editorial —

"The public's tendency to consider the tap the source and think no further, is a dangerous one. Such thinking induced New York (the most modern city in the world) to postpone undertaking projects for a suitable reserve water supply. The city's resulting uncomfortable predicament a few years ago is well known.

"Bernard Baruch has told U. S. senators that in 53 years water will be more valuable than oil in the nation because of increases in industrial use, in individual consumption, and in population. Several areas of the country are already afflicted by drought and have experienced water shortages."

Florida is blessed with such an abundance of natural resources, including water, that the people are sometimes deceived and imagine these resources inexhaustible. They are not. Planning and conservation are needed. But planning and conservation are not measures that can be taken at the last moment; they are preventives, not remedies. If the state is to have the supply of water it will need in future years, the time to start planning is now. When the water fails to flow in the tap, it is already too late.

Florida Water Resources Study Commission

Florida has already made a start on preliminary studies which are necessarily in the proper planning and protection or conservation of its water resources. As directed by Chapter 29748 of the 1955 State Legislature, a Florida Water Resources Study Commission was formed in 1955. Under the leadership of Byron E. Herlong, as Chairman, and Dr. David B. Smith of the University of Florida as Director, the commission made a comprehensive study of the physical, administrative, and legal aspects of water problems and water management in Florida, and rendered a 94-page report on the results of its studies to the Governor and to the 1957 Florida Legislature.[8]

In keeping with the Commission's recommendations, the 1957 State Legislature established a Department of Water Resources under the State Board of Conservation. John W. Wakefield, formerly of the Bureau of Sanitary Engineering, Florida State Board of Health, is Director of the new department.

As recommended by the Study Commission, the Board has regulatory powers which include the following functions:

a. To authorize the capture, storage and use of water, including flood waters, in excess of reasonable uses; and to authorize the diversion of such waters beyond riparian or overlying land; and

b. To establish reasonable rules for conservation of water in regions where diversion of surface or underground waters threatens to exceed the natural replenishment of such waters or to render them unfit for use by reason of salt water intrusion or other causes.

Certainly the granting of such powers is a step in the right direction, and if it functions properly, the Board will render a real service to the State of Florida. Of course, the actual planning of water resources to meet metropolitan expansion is a job for the consulting sanitary engineers, but an important function of the Department of Water Resources is to help in guaranteeing that a suitable water supply once developed will remain of satisfactory quality. The value of safeguards against salt water intrusion from overpumping, for example, is readily apparent to almost everyone in sections of the state where ground water supplies have been ruined already by salt water intrusion.

Another very serious problem requiring careful planning and study in Florida is concerned with the contamination of ground water supplies from sewage discharging to sinkholes in porous limestone formations. An otherwise good water supply and municipal water softening plant had to be abandoned because of sewage contamination through a sinkhole in Lake City. And in 1948, dye placed in the sewage effluent from the University of Florida showed up ten hours later a mile and a half away in a well owned by the City of Gainesville. It is apparent, therefore, that studies involved in the planning and development of water supply resources to meet metropolitan expansion should have the benefit of the best qualified independent consultants who are experts in the various phases of water supply work requiring expert knowledge. To date, some 25 sanitary engineers in Florida have been certified by the American Sanitary Engineering Intersociety Board in the specialty of Water Supply and Waste Water Disposal.

Although the situation with which the City of New York has been confronted has many historic parallels in smaller metropolitan areas, and all metropolitan areas should take heed of such close calls as the one which

"In order to make accurate estimates of future water consumption, an engineer must study all of the existing analyses and forecasts which he can uncover.

occurred in New York, the political, economic, and engineering problems in the development of adequate metropolitan water supplies are in many respects different for each area or community. However, there are certain fundamental engineering procedures which are similar in most cases.

Estimates of Population and Water Consumption

Usually, the first step in the planning, design, or development of a water supply system is to predict the future water consumption. To make this prediction, it is desirable to examine and to estimate separately, population growths and per capita consumption rates. The product of these figures is the predicted total consumption.[5]

In order to make accurate estimates of future water consumption, an engineer must study all of the existing analyses and forecasts which he can uncover. There are a number of sources of information which may be helpful in estimating probable future populations. Among them are chambers of commerce, U. S. census reports, health department statistics, and estimates of school boards, power companies, and telephone companies. Often there are special reports and analyses, but the utiliziation of all such reports must be tempered with a considerable amount of judgment.

As everyone knows, Florida is experiencing a phenomenal growth. Its present population is estimated at 4,300,000. In five years the population is expected to increase by 33 per cent, to 5,800,000. A 75 per cent increase or a population of 7,500,000 is predicted in ten years. Of course different areas will grow at different rates, the prediction being 24 per cent in ten years for the middle northern part of the state (including Tallahassee, Gainesville, and a few other spots which will grow faster than the average) to 93 per cent for the East Coast, South, including Dade, Broward, and Palm Beach Counties of the so-called Gold Coast.

In other words, Florida is going to have more metropolitan areas, of which some will be developing much more rapidly than the average for the state as a whole. The problem of furnishing water to this rapidly increasing population is compounded with a rapidly increasing rate of consumption. During the past few decades the consumption of water has been increasing at a rate of about one gallon per person per year. It has been more rapid than that since World War II because of the increased use of water consuming devices in the home. Automatic dishwashers, automatic laundry machines, air conditioning equipment, garbage grinders, and other household appliances add considerably to the water consumption. The present consumption rate in Florida is estimated at 125 gpcd, while the national rate is about 145 gpcd. If we continue at the present annual rate of increase the per capita consumption in Florida may be in the neighborhood of 165 gpcd by the year 2000. These and other factors must be taken into consideration in the planning and development of our water supply resources.

Taking the nation as a whole, our industrial water requirements are expected to double by 1975. For Florida, the industrial requirements should increase at a much larger rate, or on a scale more comparable with that of its phenomenal growth in population. The effect of such an impact on water resources planning and development cannot be overestimated.

The second step in the water supply planning and development program for a metropolitan area should be that of making a thorough inventory of all available water resources. Some will suggest that this should be the first step — and well it should in some instances. Such was the case in studies recently completed on a water resources planning program in California where some estimates of water requirements have been out of date even before they were published. The situation in some parts of Florida is not far different from that in California, although Florida's water resources are much more adequate relatively than are those of California.[9] As with California, however, the rate of development in parts of Florida is so fantastic that it must be seen to comprehend it fully.

The third phase in the water supply planning program for a metropolitan area should be that of developing a master plan for supplying the water. And, finally, the plan must be put into effect. An engineer can produce excellent plans and reports, but these will be worthless if they rest on the shelf gathering dust.[10] Unfortunately this is what happens in many cases. A good engineer can do much to prevent it from happening, however, and he has a responsibility for so doing. His recommendations and reports should be couched in terms meaningful to the public and the basis of his recommendations should be well understood.

"Water flowing from the tap has become such a dependable service that most of us now regard it as one of the absolutes."

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A circuit diagram for automatic cut-in . . .

Auxiliary Beacon Lights

by PAUL C. ZIEMKE
Clinton, Tenn.

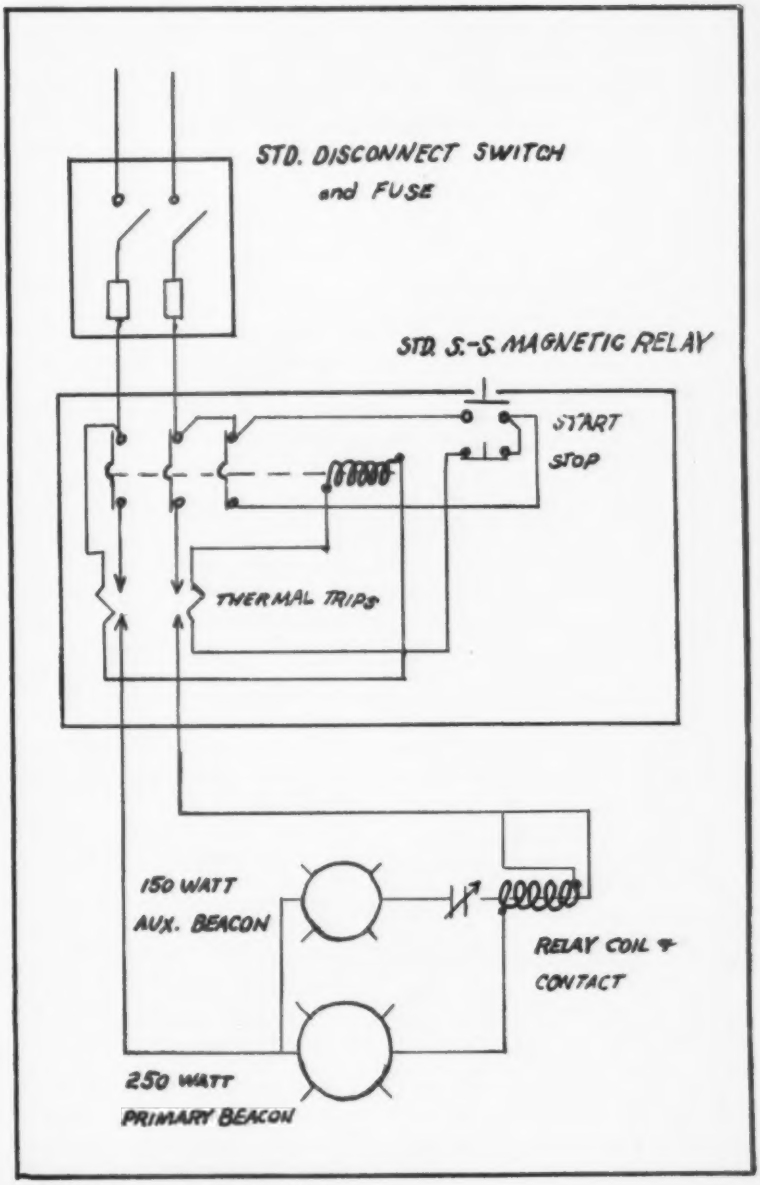
RESUME: Aircraft warning lights mounted atop elevated structures, such as water storage tanks, usually fail at the most inopportune periods. Circuit arrangements can be installed to automatically light auxiliary lamps on these occasions.

■ AUXILIARY beacon lights which light automatically have been accepted with zeal by electrical men who have had to climb elevated storage tanks at midnight to repair lamps. A standby lamp eliminates this need and still assures due warning to low flying aircraft. The automatic cut-in of the auxiliary beacon upon failure of the primary guards against any interruption in service.

The diagram illustrates a simple means of employing a standard two line 160 Volt, A.C., 60 cycle Stop-Start magnetic relay with thermal trips and a standard disconnect switch and fuse installation. The arrangement allows for the ordinary overloads which might inadvertantly develop on the conduit run or in the lamp enclosure.

A relay holding coil and "normally closed" (N.C.) electrically operated contact can be installed in series with the primary beacon. These items may be obtained from any electrical supply house, however, care must be taken to select a holding coil which will give approximately the same current flow through the lamp and the coil. Under this arrangement, when the primary lamp fails the relay holding coil is de-energized and the contact closes. The circuit to the auxiliary lamp is, therefore, closed and the lamp lights automatically.

If the auxiliary lamp is of a different wattage than the primary, plant guards or other night personnel will notice the difference in brightness and report the failure. Maintenance can then be completed as the schedules permit.



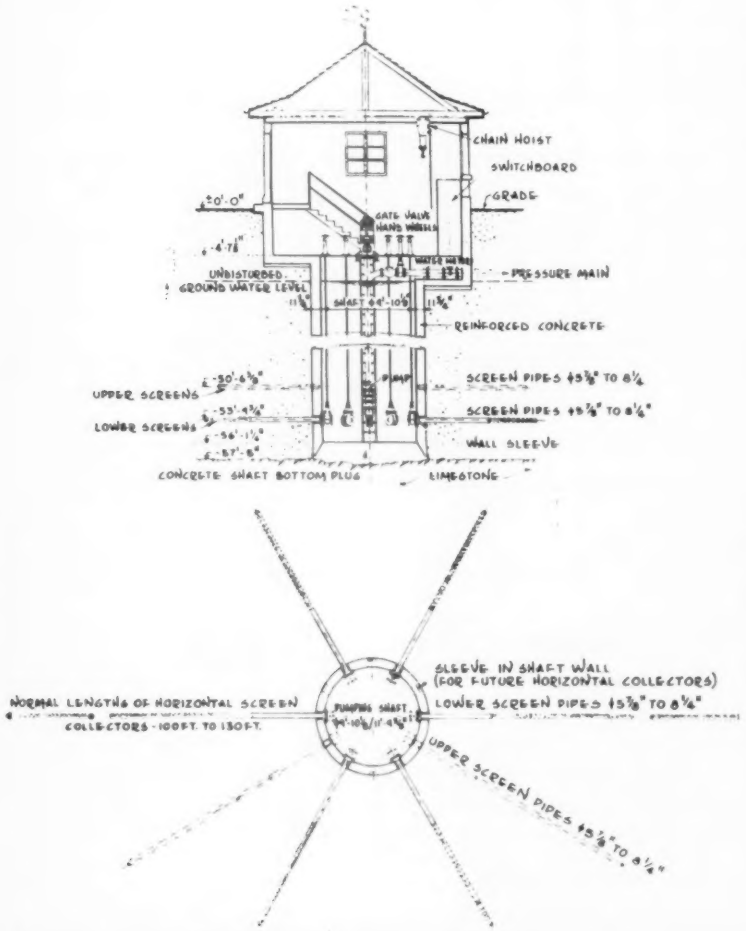
CIRCUIT diagram for auxiliary beacon.

Growing water shortages and increasing water demands in Europe led to the development of a new Swiss . . .

Subterranean Water Collector

by H. FEHLMANN and J. H. FEHLMANN
Fehlmann Hydraulic Engineering, Inc.
Berne, Switzerland

EDITOR'S NOTE: From time to time, it is our plan to bring, to our American readers, information on practices, equipment, and ideas from other countries. This article describes a relatively recent development in Switzerland of a system of underground water collection. The article is presented solely for information and not in any effort on the part of WATER & SEWAGE WORKS to compare it to either similar or dissimilar methods used in the United States.



WATER COLLECTOR with horizontally arranged screens.

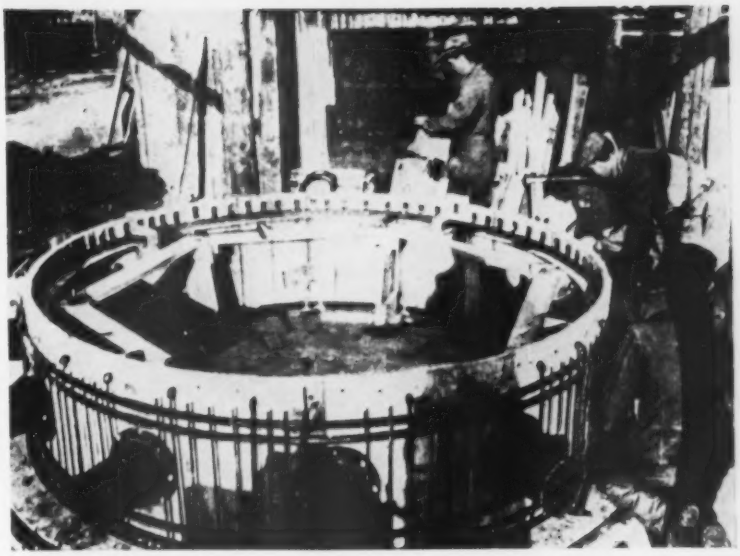
■ WITH THE PAST and current water shortages, increased emphasis has been placed upon providing adequate safe water supplies for municipalities, industries, and irrigation works. Since many sections of the Country are dependent upon ground water as a source of supply, any method of improving ground water collection bears investigation.

Until relatively recently the classical way of collecting ground or subsurface water was by means of well points, shallow wells or deep wells. When the subsurface aquifer is in sand or gravel, the well may be gravel-packed to increase its yield. Wells may be installed by sinking a casing, with a diameter varying between a few inches and several feet vertically, into the water-bearing stratum or strata. Methods used for sinking vertical wells and gravel packing are fairly standard and need not be reviewed.

Since the capacity of a vertical well is mainly determined by the wetted screen surface, enlarging this surface is the only method for increasing the yield. An increase in diameter of the screen only results in a relatively small increase of screen surface while the actual installation cost increases rapidly. An increase in the length of the vertical screen is usually limited by the depth of the water-bearing stratum. For these reasons, therefore, the capacity of a vertical water collector is limited. An additional disadvantage is the fact that the water level in the well and aquifer decreases with increasing pumping capacity resulting in a declining wetted screen surface. At the same time, the velocity of the water entering the screens increases since less screen surface is available for the water to enter the well. These high water velocities are

dangerous because sand may be carried into the well, clogging it up. Another disadvantage is that each well requires a separate pump together with required piping which increases the cost for construction and operation of a battery of wells.

Investigations by the Management of the Water Works of the City of Zurich, Switzerland, with their Hardof Collector, have shown that the quality of the water from vertical wells can become unacceptable for potable use. Their study revealed that a vertical flow pattern can be established around vertical wells allowing inadequately filtered surface to seep in, not only contaminating the water but causing unfavorable temperature fluctuations.



SHAFT SECTION with sleeves being prepared for pouring concrete.

Horizontally Arranged Screens

The ever increasing demand for water domestic and industrial uses in Europe required that means be found to provide large quantities of water at low cost. It appeared desirable to develop a subterranean water collector with the following characteristics:

1. Low initial construction cost;
2. Low operating cost;
3. High capacity;
4. Maximum usage of subsurface water.

Since the collection of water from shallow water tables by installation of drain pipes and drainage galleries leading to collection sumps and shafts is known, it was natural to apply the method of collection of surface water by means of horizontally arranged screen pipes from a central shaft lowered into the water-bearing strata. Such shafts have been lowered into the ground to considerable depths in the Near East (Persia, Syria, Iraq, Israel, etc.) since ancient times. The shafts are lowered into the water-bearing strata, and from the bottom, horizontal galleries are manually driven out into the aquifer to collect the water and drain it into the central shafts. The use of horizontal collectors in ancient times, however, was restricted to water-bearing strata where the volume of water was low, since practical methods of installation were not available in high water-bearing aquifers. Therefore, the thought of collecting large quantities of ground water in shafts with horizontal supply lines is not new. The new feature is the method whereby the horizontal collectors are installed out of the central shaft into aquifers of any permeability and capacity.

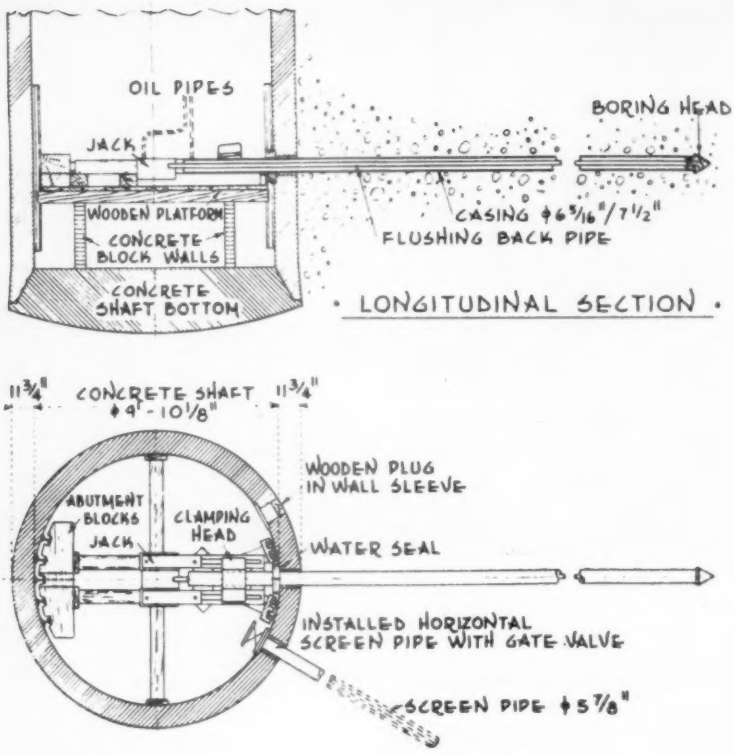
The Ranney Method of collecting subsurface water with horizontally advanced borings was established in Switzerland prior to World War II. The system was primarily developed to extract oil from oil saturated fine gravels and sand. The method projects slotted steel pipe with wall thickness varying between $\frac{3}{8}$ and $\frac{1}{2}$ in. into water-bearing strata from a selected point or points of a reinforced concrete shaft using hydraulic jacks.

The front end of the slotted pipe is provided with a slotted boring head; in the finished well, the slotted pipes used for boring remain in place acting as collectors, draining water from the aquifer into the central shaft. The characteristic feature of the Ranney Method is that steel pipe with slots of a previously determined size is used. If the soil characteristics encountered during the actual horizontal boring vary from the material anticipated when the slots were designed, there is no provision for increasing or decreasing the slot sizes.

Prior to construction of a well with horizontal collectors, certain primary facts should be considered. A modern subsurface water supply system should have a high capacity with low installation and operating costs. It should provide a means for maximum use of available subsurface waters; i.e., it should be able to remove large quantities of water from the water-bearing strata without adversely affecting the quality and quantity of water in the strata itself, thus maintaining a consistently reliable supply. The velocity of the water entering the collector should be kept low enough to insure a water purity at least equal to that of a conventional vertical well. The system should be adaptable for collecting water from water-bearing strata composed of all possible material such as silt, ordinary sand, gravel, fine rock beds and any combination thereof. Provision should be made to install corrosion-resistant screen pipes with slot sizes adapted to the traversed strata. The individual runs of screen pipes should be extended from the vertical shaft out as far as possible, in order to obtain a maximum of wetted screen surface resulting in maximum collection capacity.

Considering the above points, a water supply system, combining the advantages of the conventional vertical well together with those of the horizontally arranged collector pipes, led to the development of the Fehlmann well or Swiss well.

The Fehlmann method was developed in Switzerland and was first applied in 1947 with the Aar River Ground Water Works of the City of Bern, Switzerland. Since that time, more than 50 of these wells have been completed or are in the process of being installed in Switzerland, West Germany, France, Belgium, and sev-



HORIZONTAL boring operation is shown in this drawing.

eral other European countries. The total of installed screen pipes today is approximately 10 miles and the total capacity of the wells installed is more than 220,000 gpm.

The Fehlmann well consists of a vertical shaft sunk into the ground to the depth of the aquifer, from which the horizontal borings are made into the subsurface water-bearing strata at one or many different elevations. Screens are installed in the horizontal borings, sized to provide the most effective water collection. Pumping equipment is finally installed in the central vertical shaft to pump the water to the desired point of usage.

Sinking the Vertical Shaft

The internal diameter of the concrete shaft is determined by consideration of necessary working space requirements to jack and retract the horizontal steel casings and installation of screen pipes from within the shaft proper and by consideration of its function as a water collecting pit or sump, after the installation is completed. The standard shaft has an inside diameter of approximately 10 ft with a wall thickness of 12-in., provided the bottom of the shaft well rests at a depth below ground of roughly 65 ft or less. Greater wall thickness must be provided if the shaft is to be sunk deeper than 65 ft.

During the shaft lowering operation, daily progress averages approximately 5 to 6 ft. In order to assure proper shaft alignment and overcome the skin friction of the shaft itself, it is essential that the proper thixotropic fluid be selected. It is also important to size and shape the cutting edge of the concrete shaft in such a way as to pierce the underground formations in an efficient manner. After the concrete shaft is sunk to its final depth, the bottom is sealed with a concrete plug, poured under water. It is essential that the shaft walls and bottom plug be completely watertight.

Sleeves are provided in one or several sections of the reinforced concrete shaft fabricated at the site. Knowing the formation from an exploratory boring and the ultimate depth the shaft is to reach, the sleeves are placed in such a way that, upon completion of the shaft, they come to rest opposite the aquifer at the most advantageous elevation for installation of horizontal collector screens. Later, the casing to carry the screen will be jacked out through them. Depending on shaft diameter and capacity of aquifer, up to 32 and more such sleeves can be placed at one elevation in the shaft. Before the sleeve provided shaft sections are sunk into the formation, a multipart wooden plug is used to close the sleeve at the outside of the shaft. The inside is sealed with blind flange and gasket.

Horizontal Boring

After the shaft bottom is sealed with a concrete plug the water is pumped out of the shaft and the jacks and other equipment for the horizontal boring operation is lowered and set up at the elevation of the previously installed sleeves. After removing the blind flange of one of the sleeves, a heavy casing with solid walls and threaded ends is jacked through the sleeve and out into the water bearing formation. A boring head provided with openings is slipped onto the forward end of the first section of the casing. Sand and gravel removed from the formation forward of the boring head by the hydrostatic water pressure is flushed back into the shaft through a drainage pipe screwed into the boring head. The removal of sand and gravel at the boring head permits the casing to be projected. After completion of the horizontal boring operation, that is after the casing has reached its desired length, the drainage pipe is removed from the boring head and a check provided in the boring head shuts off any further inflow of material into the casing. Sections of screen pipe are now assembled and slipped into the casing to extend along its entire length. A wooden plug closes the forward end of the screen pipe. The casing is withdrawn from the formation by reverse operation of the jacks and disassembled in the shaft, while the boring head is lost and remains in the formation.

The design of the boring head permits an accurate guiding of the casing. It is therefore possible to project the casing in a perfectly horizontal direction or to slant it upwards or downwards to best suit local conditions. The clamping head of the hydraulic jacking machine that holds the casing is designed in such a way as to permit a reciprocated movement of the double acted jacks without disengaging the casing. This arrangement

provides the possibility to retract the casing with the boring head from time to time by a small length enabling the compressed strata in front of the boring head to loosen up and to enter the openings of the head more freely. This reciprocating movement of casing and boring head pushes stones up to head size out of the way. The openings in the boring head are arranged in such a way that threaded steel rods can be pushed through this head and beyond it. Boulders, conglomerated lenses of gravel and other obstacles in the formation can therefore be overcome by blasting forward of the boring head.

Collector Screen Pipes

A big advantage of the method described is the full protection of the screen pipe by the casing during its installation. Partial plugging of the screen slots cannot occur when the screen pipe is introduced through the casing in the water bearing formation.

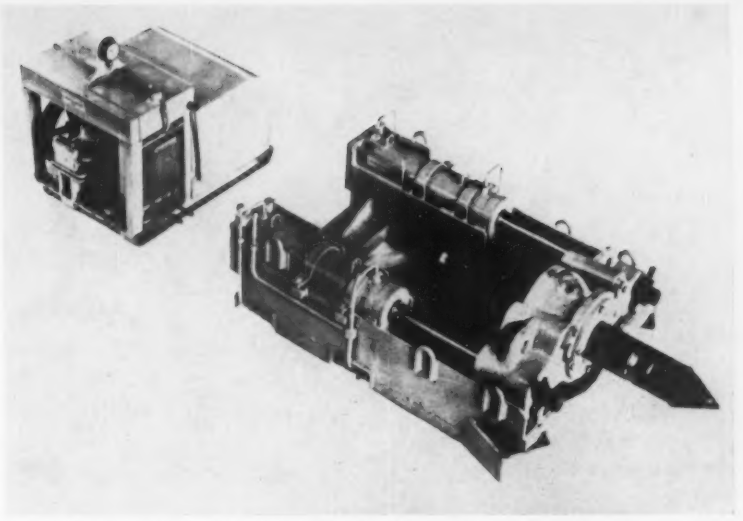
In order to obtain a maximum flow of water from a well, especially if the water source is a shallow aquifer, it is very important to install the collector screens near the impervious layer. On the other hand, the screen pipes must be situated sufficiently above the impervious layer to guarantee unobstructed inflow of the water into the screen along its complete circumference.

The standard screen pipe used for the Swiss-Well has a slotted surface of 25% to 33%.

Withdrawal of Casing

As described above, the steel casing is withdrawn from the formation after the screen is installed within. It is understood that the casing, while being advanced, moved back and forth and withdrawn from the formation, has to endure very heavy stresses and strains. Therefore, the casing is manufactured of heavy walled steel pipe in short section with threaded ends. The threads are cut directly in the pipe to avoid any thickening of the pipe section at their joints.

Only the thin walled, slightly stressed, and therefore, relatively inexpensive screen pipe remains in the water bearing stratum. These circumstances have a favorable influence on the economic considerations of the method.



JACKING MACHINE with driving unit for the standard diameter well.

Screen Slot Sizing

When jacking a casing horizontally out into the aquifer, all components present in the formation are washed back into the shaft by the static head of the water in the aquifer and can be collected there. Therefore, a completely accurate picture of the pierced formation can be established and thus, the amount and size of the slots in the screen pipe can be chosen to be of maximum efficiency.

While the casing is advanced, samples of the material flushed back into the shaft are taken continuously and any change in granulation and strata is carefully noted on the drilling log. Because the collector screen is installed only after the jacking operation of the casing is completed, the size and number of screen slots can be accurately adapted to the changing granulation of the pierced strata. If the taken samples show that the aquifer is composed largely of fine and/or very fine sands, screens with very narrow slots must be chosen to guarantee completely sand free water. In such extreme cases, the size of these slots is determined by sieve analysis of the collected samples.

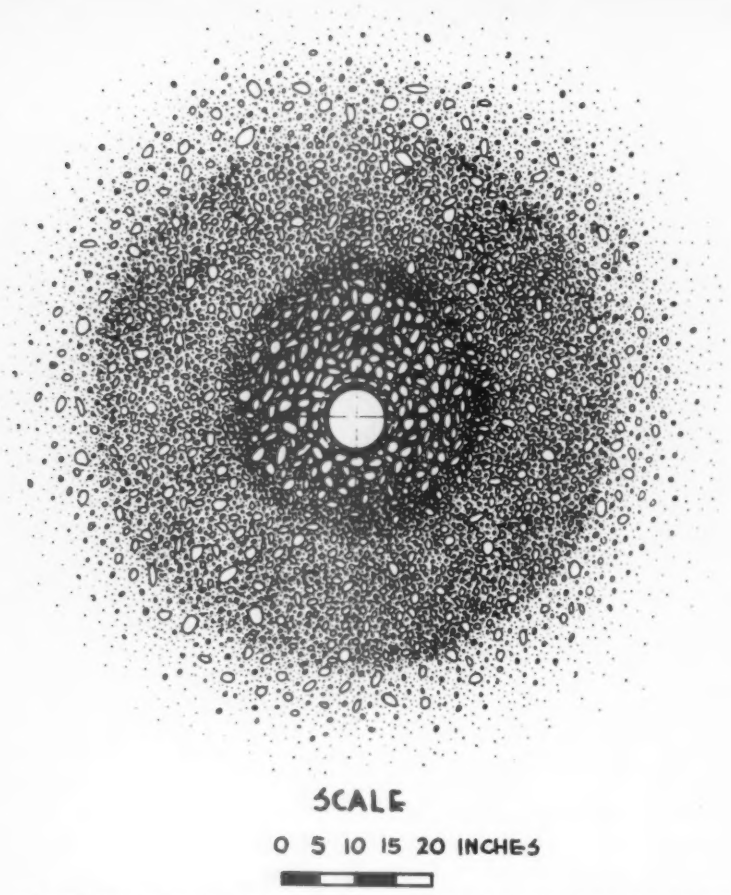
If the casing should have pierced silt and clay lenses, these areas will be closed off with solid wall pipe so that no water whatsoever can enter the collector from such strata. This is very important as no screen or sieve is fine enough to prevent such materials from entering the collector. As a further measure, the solid wall pipe is installed to protrude from these lenses in both directions by a sufficient length to prevent the fine materials from creeping along the outside of the solid wall pipe and entering the collector where the slots start again. One such screen with various slot sizes and sections of solid wall pipe is installed in a horizontal water collector on the lower Rhine river in Germany; it traverses 12 different strata in 240 ft of penetration.

Filtering Layer Around Screen

If the water pumped from an aquifer is not completely free of sand, a lot of harm can be done to the whole water handling installation. Absolutely sandfree water during its whole life is the basic requirement for every well. To ensure completely sandfree water, one or more gravel layers with different grain sizes are usually placed around the screen pipe in the vertical well.

The filtering effect of such gravel beds is based on the fact that only grains with a diameter ¼ to 1/5 the size of the mean grain size of the gravel bed can slip through and enter the well. As the aquifer surrounding the gravel beds are flushed out during a pumping test previous to commercial operation, all fines are removed and sandfree water will be obtained. One or two gravel beds of correctly chosen grain size can retain all fines and ensure water completely free of sand.

In vertical wells, the filtering gravel



FILTERING LAYER established around a horizontal screen by the boring action and the desanding pumping test.

beds have to be carefully installed around the screen pipe. In horizontal wells, on the other hand, gravel beds are established as a naturally occurring secondary phenomenon while advancing the casing horizontally out from the central shaft. During the jacking operation, water enters the openings of the boring head with high velocities and therefore, drags along the sand-gravel material situated in the vicinity of the boring head. This material is flushed back into the vertical shaft through a special flushing pipe placed inside the casing.

Prior to the horizontal boring operation, the size and shape of the openings of the boring head are carefully chosen to give the most favorable conditions for the removal of sand and gravel from the aquifer. The size of the openings in the boring head limits the grain size of material that can be removed from the formation. The pebbles that are too big to enter the openings in the boring head deposit around the casing and constitute a filtering gravel layer.

The depth of this filtering layer depends on the water velocity entering the boring head. By varying the amount of gravel and sand removed from the aquifer and by more or less reciprocating the casing during the jacking operation a filtering layer of proper depth and efficiency can be established. According to conditions and grain size of aquifer 5 to 15 gallons of sand and gravel are removed from the aquifer per linear foot of casing projected.

The fine grains remaining in the filtering layer around the casing are removed after the screen pipe is installed and the casing withdrawn simultaneously with a pumping capacity test. All screen pipes but one are closed with gate valves in the central shaft. A high capacity pump is installed and a water quantity much higher than the one to be pumped on commercial operation is removed from one screen at a time. This results in a high water velocity along the collector on its entire length flushing out all fines that can pass through the previously established filtering layer and the slots in the screen. By this flushing action a filtering layer with decreasing grain size towards the aquifer is established much like the one manually installed in the vertical well. The quantity of sand removed from the aquifer during the pumping test is relatively small and closely checked so that no voids can be built in the aquifer which later might collapse and plug the collector.

Protection Against Corrosion

Corrosion is a great danger for all water handling pipe and conduits, especially if the water is of aggresive nature. Collector screens, being constantly submerged, are especially endangered by corrosion and, therefore, must be especially well protected against corrosion, more so even, because it is not possible to exchange them if they should corrode.

Because all mechanical abrasion is completely avoided when installing the collector screen pipes according to the Fehlmann-System, the screens can be provided with a surface treatment sufficient to prevent corrosion in many cases. Good results were obtained by hot galvanizing the screen pipes, by applying hard-rubber coatings and by painting the screen with several layers of polyvinyl chloride lacquer.

Because the screen pipes of the Swiss-Well have to take practically no stresses during installation and commercial operation of the well and thus can be light-walled, it becomes economically feasible to manufacture the screens of practically any material. In aggressive ground water even stainless steel screen pipe (18% Cr., 8% Ni., 0.07% C) can be used in an economical way. Other possible materials are copper, wood, ceramics and synthetic resin.

Synethic resin such as polyvinyl chloride or polystirole is completely corrosion resistant in any groundwater and can be obtained at economically feasible cost. Because of the very light stresses occurring in the screen pipes, it is possible to manufacture screen pipes of synthetic resin up to 12 inches inside diameter.

In this time of growing water demands, it is the responsibility of each community's water utility to provide proper . . .

Elevated Tank Maintenance

by E. D. BARRETT, District Sales Manager
Chicago Bridge & Iron Co., Detroit, Mich.

EDITOR'S NOTE: Here in brief form are some of the basic principles of a sound preventive maintenance program for elevated steel water storage tanks, together with a standard report form used by field foremen inspecting steel tanks for the author's company. This paper was originally presented as part of a symposium on Tank Maintenance at a meeting of the Michigan Section of AWWA and released for publication in *Water & Sewage Works*.

■ YEARS AGO very little attention was given to preparation of the steel surfaces prior to painting in various shops, after fabrication and before shipment. Specifications always called for surface preparation to include removal of dirt, grease and loose millscale. Insufficient recognition was given to the fact that forming of steel always caused cracks in the mill scale; cracks that are minute and not enough to loosen the scale, but which are the starting points for later paint film failures.

Shop Paint

The shop paint coat was applied over this surface and the formed plates were shipped to the site. This was accepted practice and the majority of tanks built prior to 1946 were painted in this way. Since 1946 the industry has become conscious of the importance of clean, dry surfaces in preparation for painting. It is a fairly safe assumption that owners of tanks that have been built under this later thinking, using pickling or sand blasting to base metal, will have relatively less maintenance problems.

Consulting engineers and regular tank builders are therefore starting a "Preventive Maintenance" program at the source. However, all the engineers and tank builders can do from that point on is to advise and warn the owner. It is up to each community to provide for maintenance that will give trouble-free service.

During the development of designs of elevated tanks most items with moving parts have been eliminated so that all that is left is a program of regular inspection and painting.

It is hard for manufacturers to understand why so many owners neglect their elevated tanks. Almost all water departments set up meter repair programs, pump servicing, hydrant testing and pipe cleaning programs, but an elevated tank, a big item of original cost, is like a step child whose shoes are never shined.

So often a tank is painted on the outside for appearance with no inspection or painting being accomplished on the inside. As an example, one elevated tank in Michigan has had no inside paint for over 25 years.

Budgeting for Maintenance

All water superintendents have a big problem to overcome in setting up a budget and adhering to a sound "Preventive Maintenance" program. Municipal boards or commissions changes at regular intervals and few councils like to leave office with a record of having spent money for things that cannot be seen. Everyone would like to leave a monument indicating progress and growth. It is very easy therefore for board members to look up 100 feet in the air and say: "It looks to me as if it would last all right for another year or at least until after the coming election." This elimination of maintenance expense often occurs over many years; each succeeding board finding more interesting use for the scarce dollar and there are many tanks that have been uncared for during long periods of time.

On the positive side of the ledger one thing is of help to everyone. That is the fact that public bodies are becoming more conscious of the value of advertising. Boards are hopeful of growth and new tax paying industry; consequently, appearance is more and more important. The elevated tank is a prominent structure in any community and only a well maintained structure in constant service provides good advertising.

The outside of a water tank will usually receive better maintenance than the inside, but it is the inside that is most important.

Preventive Maintenance

Preventive Maintenance on elevated tanks consists of a very few items well planned. First, one should know the corrosive quality of the water. This will determine the frequency of inspection and care required. Surface water supplies and "soft" waters will usually require more frequent care than the harder waters from well supplies. A program of inspection every five years should be instituted where waters are high in oxygen content or are "soft." If the water is from deep well supply, a program of inspection every seven years should be satisfactory.

The second item on a maintenance program, after determining frequency, is the nature of the inspection. The accompanying printed form was developed after many years of experience in design and construction of tanks. The items covered by this report should all be covered. Experienced companies which build elevated tanks maintain regular inspectors and accomplish this inspecting on a low cost basis. There are also regular inspection companies whose services are for

FORM G.O. 1

CHICAGO BRIDGE & IRON COMPANY

Inspection Report No. 3.

Inspection Contract No. _____ Original Contract No. _____

Location: Street _____

City _____ State _____

Present Owner _____ Original Owner _____

Capacity _____ Type Bottom _____ Height Bottom _____

Type Construction (Welded, Riveted) _____ Number Tower Panels _____

Year Built _____ Inspected By _____ Date of Inspection _____

REPORT OF INSPECTOR

1. Are anchor bolts rusted so as to materially reduce their strength? _____ If so, calliper and advise smallest section. If possible, examine carefully where bolts enter concrete. _____

2. Are anchor bolt nuts tight? _____

3. Are column shoes in good condition? _____ Are they clean and painted or has dirt accumulated? _____ If seriously rusted, state where and depth of rust. _____

4. Are the anchor bolt connections on standpipes and tubular columns in good condition? _____ Has their strength been materially reduced by rust? _____ If so, describe. _____

5. Are tower posts in line? _____ If answer is "no" describe condition _____

6. Is there any indication of settlement in the foundations? _____ If answer is "yes" describe condition. _____

7. Are tower rods in good adjustment and well tuned up? _____

8. Are tower rods in good condition? _____ If they are badly rusted so as to reduce strength, measure the smallest part and report. Be sure to state in what rods this occurs. Examine particularly condition of rods around pins. _____

9. Are there two cotter pins well spread in each end of all long pins and one cotter pin well spread in each up-set pin? _____ If rod pins with nuts are used, advise if nuts are on with full thread and the end of thread well battered. This is important. If cotters come out or nuts drop off, pins may come out with the result that tank bracing will be loosened and a collapse of the structure will result. EXAMINE EACH PIN _____

10. Is riser pipe or riser cylinder straight? _____

11. Are riser pipe or riser cylinder stay rods in good condition? _____

12. Is the frost casing in good condition? _____

13. Is the frost casing supported by substantial foundation? _____

14. Are there any indications of leaks in riser cylinder, or in riser pipe or in expansion joint? _____ Describe _____

15. Are there any indications of leaks in tank? _____ Describe _____

16. Is the ladder safe? _____

17. Is the balcony safe? _____

18. Is balcony floor in good condition? _____ State the amount of rust and how much dirt has accumulated thereon. _____

19. Report any bolts or rivets which are not in place in the splice connections of the tower, struts and balcony. (Missing bolts should be replaced by the inspector.) _____

20. State condition of paint and metal of tower. Look particularly inside of columns and struts, under lacing bars and post connections, at strut connections and at all more or less difficult and concealed places _____

21. State the condition of the paint outside tank and riser:

Large Riser Cylinder: _____
Bottom: _____
Shell: _____
Roof: _____

22. State the condition of the metal outside tank and riser:

Large Riser Cylinder: _____
Bottom: _____
Shell: _____
Roof: _____
Is finial connection solid? _____ If "No" describe. _____
Is the revolving ladder safe? _____

23. Was the tank emptied for inspection? _____ If not completely emptied, state how far down. _____

24. Is the tank equipped with a rust prevention system? _____
(a) If so, what type (suspended electrodes, outside anodes, etc.)? _____
(b) State name of manufacturer. _____
(c) When was system installed. _____

25. Is the tank now equipped with a float-type indicator? _____ If so, is it in good condition and working? _____

26. State the condition of the paint inside:
Large Riser Cylinder:_____
Bottom:_____
Shell:_____
Roof:_____

27. State condition of the metal inside:

Large Riser Cylinder:
Is cylinder pitted?_____No. of pits per sq. ft._____. Describe pits as to size and depth.
_____
Is pitting localized or general?_____
General Comments:_____
_____

Bottom:
Is bottom head plate pitted?_____ No. of pits per sq. ft._____
Are bottom bowl plates pitted?_____ No. of pits per sq. ft._____
Describe pits as to size and depth. Head Plate_____
Bowl Plates_____
Is pitting localized or general_____
General Comments:_____
_____

Shell:
Is 1st ring pitted?_____ No. of pits per sq. ft._____
Is 2nd ring pitted?_____ No. of pits per sq. ft._____
Is 3rd ring pitted?_____ No. of pits per sq. ft._____
Is 4th ring pitted?_____ No. of pits per sq. ft._____
Describe pits as to size and depth 1st ring_____ 2nd ring_____
3rd ring_____ 4th ring_____
Is pitting localized or general_____
General Comments:_____
_____

Roof:
Is roof pitted?_____ No. of pits per sq. ft._____. Describe pits as to size and depth
_____
Is pitting localized or general?_____
General Comments:_____
_____

28. State condition of spider and spider rods._____
29. State condition of inside ladder._____
30. State condition of rivets at lap joints and at post connections._____
31. State condition of metal between rivets at the laps and at the post connections._____
_____
32. Examine any valves and advise if leaking. This refers particularly to blow off valve, if furnished.
_____
33. Is bottom covered with mud or scale?_____ If so, to what depth?_____
34. Does outlet pipe stick up above accumulations of scale?_____. Are there indications that some of this dirt and scale has entered the riser pipe?_____
_____
35. Structure was last painted inside about_____ Type_____ Outside about_____ Color_____
Previous to that it was painted inside about_____ Type_____ Outside about_____ Color_____
Previous to that it was painted inside about_____ Type_____ Outside about_____ Color_____

36. General Statements as to condition of structure._____
_____
_____
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_____
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37. Repairs made by Inspector._____
_____
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38. Repairs recommended._____
_____
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_____
_____

39. Inspection report should be sent to_____
_____

Signature of Inspector_____

Date_____

A GOOD APPROACH to a sound preventive maintenance program is to have a regular inspection of elevated tanks. The number of years between inspections depends on several factors. This form, as shown on these two pages, lists a number of questions pertinent to a proper inspection.

hire and who will provide experienced men for the job.

The next step is following the recommendation of the report. Corrosion or deterioration of steel structures can be minimized or even eliminated by regular care. There are two accepted methods of inside tank maintenance. One is by painting, the other is by the use of properly designed cathodic treatment. Since the latter is a special field, only painting will be discussed here.

Sound Painting Practice

The one condition that hurts good painting practice is the fact that few municipalities can take a tank out of service long enough to properly dry out the inside. Everyone knows that paint will blister or will not properly bond if the surface is not completely dry. Therefore one should plan on a minimum of one week for drying time and then only if both top and bottom manholes are off in order to induce a good movement of air. A blower placed in the opening of the manhole in the riser will speed up air movement and drying time.

Careful preparation of surfaces by the painter is the next important item. Be sure that all loose paint is removed and all surfaces wire brushed. Surface preparation usually requires about 80 per cent of the total time taken for a one coat job if the work is carefully accomplished.

All bare areas should be spot painted after being cleaned to bright metal. This spot paint must be allowed to dry properly before any final paints are applied. Paints with excessive "driers" added are not the answer. Only time will do the job if a good bond is to be expected. The biggest problem is the small tank because painters can clean, spot and final paint all in a week when two to three weeks is the minimum time for the job because of proper drying.

Next, do not put a tank back in service for at least a week after inside painting. Drying time again is required for good results.

With reference to paint materials, a superintendent should acquaint himself with the specification prepared by AWWA. A group of experienced men took the time to gather evidence and came out with the material set forth. There is no cure-all, no miracle paints or coatings that have proven superior to this AWWA specification. If improvements in coatings appear both the AWWA and the tank builders will be the first to say so.

Ordinances

In order to budget and program well planned "Preventive Maintenance" it might be necessary to consider positive means to that end.

If a community sees the importance of such action, an ordinance can be written requiring a sinking fund to be set up and used at certain specified times for inspection and maintenance, and no doubt, such a condition could be inserted into each bond issue requiring such sinking fund and regular use for "Preventive Maintenance."

In general, water works men should back away from laws and rules forcing them to accomplish things but in this case with changing councils and boards it may be the only way to accomplish proper care of the structure.

As to actually required repairs: the repairs of any magnitude are on old riveted tanks and this point is important; no repairs or replacements of parts in contact with water should be made unless an actual leak appears. If a leak does occur, the contractor who built the tank should be called in. He has detail plans and experience and all regular builders of tanks want to be helpful in such cases. There is no standard procedure for making repairs. Inspection, engineering experience and actual construction experience are required in each case to come out with the proper answer for the least over-all cost.

Modern design, improved original preparation and priming with high quality paint materials will produce longer trouble-free service in elevated tanks.

Shown at the end of this article is a questionnaire sent to C B & I customers who purchase water spheres. This questionnaire produces the reasons for the purchase, the service, and the manner in which the owners intend to keep it in good condition.

Questionnaire on
Maintenance Practice on Watersphere

1. (A) What is the nominal capacity and height of your Watersphere?
   (B) What service does your Watersphere provide?
   Municipal water storage ——
   Industrial general service ——
   Industrial fire protection ——
   Primary source for fire protection ——
   Secondary source for fire protection ——
2. How often do you inspect your Watersphere, or have it inspected?
3. (A) Have you established a painting schedule?
   (B) If so, how often do you paint or plan to paint your Watersphere?
   (C) Inside sphere? (D) Outside sphere?
   (E) Inside pedestal and base frustrum?
4. What kind of paint have you found to be the best for your locality and how do you apply it?
5. Do you have painting done by your own maintenance crew or by outside contractor?
6. What is your approximate painting cost?
7. (A) Do you protect the interior of the tank with cathodic protection?
   (B) If so, what type of anode do you use (material) and what is the current setting?
   (C) Name of Manufacturer?
8. (A) Do you have a service contract to check the cathodic-protection setup?
   (B) If not, how often do you check on anodes and current?
9. Have you landscaped the area around your Watersphere to blend it in with surrounding areas?
10. (A) If so, what have you done—planted trees, shrubbery, lawn?
    (B) What does its maintenance cost annually?
11. What maintenance has been necessary on heating facilities if any have been installed in your Watersphere?
12. What other maintenance have you found to be necessary?
13. (A) Do you have pumping equipment, softening unit, chlorinating equipment, etc., installed in the base? If so, what are they?
    (B) What do you store or keep in the flared base of the column?
    (C) Where would you store such material or equipment without such a housing?
14. General comment.

While development is still underway, several problems arise in supplying new occupants with

Water for Subdivision Houses

by CARLYLE WASHBURN
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Modesto, Calif.

EDITOR'S NOTE: This material was presented at the California Section Meeting, A.W.W.A., San Jose, Calif. It discusses three approaches toward administering water supplies in housing developments where some homes are occupied and others are being constructed.

Mains, No Service Lines

■ THE CONSTRUCTION OF HOUSING in a new development usually begins after the water mains are installed, approved, and accepted. A contractor then begins building a number of homes in a block of lots. He will concentrate on one house before sending certain men to begin construction on a second, third, etc., until possibly ten homes are being constructed in the block. A water service from the main to the first completed house is applied for and installed by the water company. At this point, the progressive method of building usually breaks down. The practice for testing the plumbing in the other houses in the block is accomplished by connecting a garden hose or pipe from the initial water service connection to each of the new homes as they are completed. Some contractors have gone so far as to dig up the curb cock and twist the copper service pipe over to the opposite side of the main in order to test houses on that side.

As a result of this practice, homes are sold which have either no water service connection or which have a service line so flattened, battered, or twisted that it gives poor service. The new home owner, who invariably has moved into his new home during a week-end, calls the water company and demands service.

This situation was not the fault of the water company and the individual is informed of the procedures for obtaining service. However, to satisfy the new owner's needs either a hose connection is installed from a neighbor's house or company personnel work overtime to place a line in service.

These temporary or hastily installed water service connections would be unnecessary if the contractor or subdivider followed the instructions and procedures set forth by the utility. The company usually provides descriptive drawings showing plainly what must be installed before applying for service. The real estate personnel should be held responsible to see that the contractor or construction crews are aware of the water companies requirements for obtaining water service. These experiences prompted trying a new method.

Mains and Service Lines Installed Prior to Home Construction

The practice of installing service lines to the lots prior to construction eliminates many of the problems previously discussed, although it creates new ones. Service lines from the mains directly to the lots may be installed as the subdivider desires. Each service can be shown on the definitive drawings or plans of the development.

The main difficulty experienced in this approach involves administration. Upon completion of the new home neither the subdivider, contractor, or home owner feels responsible for filing an application for water service. The water is merely turned on and used. A water company official may find twelve or fifteen homes being occupied in a block and have applications for service from only one or two of these homes. Considerable time is involved in obtaining applications from those owners who failed to apply, backdating the applications to the time the service was put into use, and including these applications in the accounting system. These administrative functions are expensive, especially when water service lines may have to be disconnected in an effort to obtain the cooperation of the home owner. The administrative workload had to be decreased.

Sealed Curb Stops

The approach toward eliminating an increased administrative work load where mains and service lines are installed prior to home construction is by sealing the curb stop. This is accomplished by using a 26 gage plate, 7½ x 4 inches, which has holes on the four corners. This plate is placed under the curb stop, folded over, and a wire threaded through the holes and joined with a lead seal which contains the company stamp.

This does not prevent the plumber from breaking the seal and attaching the house line but he knows that in doing so, he is doing something wrong. Experience with this approach has resulted in only one occasion in approximately 157 service connections where an application for water service was not filed before a house connection was made.

This approach represents the best method for reducing policing action and eliminating unnecessary administrative work loads. The problems associated with providing water service to occupied homes, while home construction continues, are never solved but less trouble is experienced in the latter approach.

Nomograph solves equation for figuring . . .

Flow of Water From Hydrants

The rate of flow of water through outlets at hydrants in city mains is given by the equation[2]: $Q = 29.83\ C\ d^2\ P^{0.5}$; where Q = rate of flow of water, gal/min; C = orifice constant for the hydrant opening (0.9) when the hydrant opening has rounded edges where it leaves the barrel; 0.8 when the edges are sharp; and 0.7 if the butt projects into the barrel of the hydrant at all; d = inner diameter of the outlet, inches; and P = gage pressure (during flow) at the hydrant, lb/sq in.

The nomograph, constructed by means of established methods,[1] enables rapid and accurate solution of the equation. The use of the chart is illustrated as follows: What is the rate of flow of water from a hydrant in a city main when the inner diameter of the outlet is 2-7/16 inches, the hydrant opening has rounded edges, and the gage pressure at the hydrant during flow is 19 lb/sq in.? Follow the key; connect 2-7/16 inches on the d-scale and 19 on the P-scale with a straight line; note the intersection with the α-axis. Connect this point and 0.9 (for rounded edges) on the C-scale with a straight line; read the rate of flow on the Q-scale as approximately 700 gal/min.

by D. S. DAVIS
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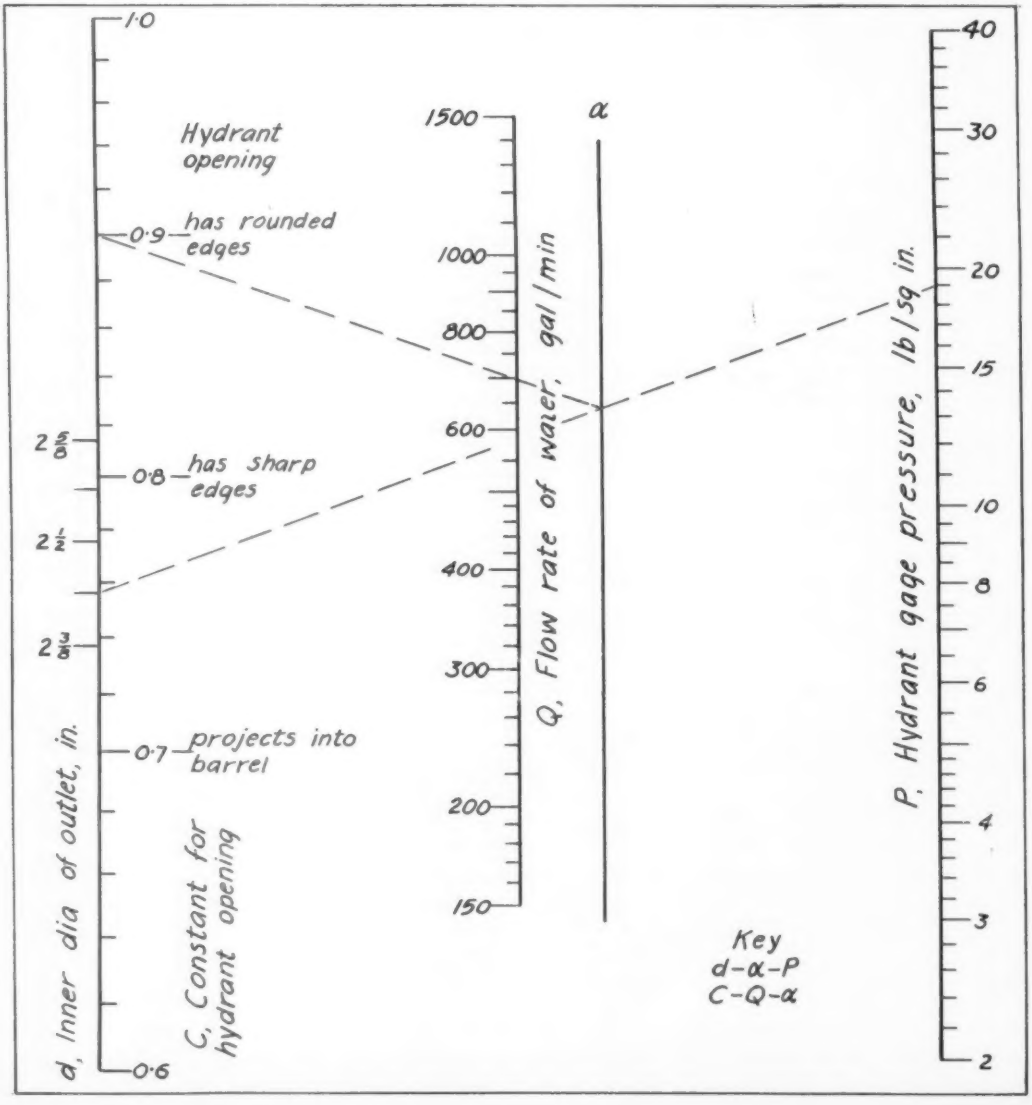
Tuscaloosa, Ala.

References

(1) Davis, D. S. "Nomograph and Empirical Equations," Chap. 6, Reinhold Publishing Corporation, New York, 1955.

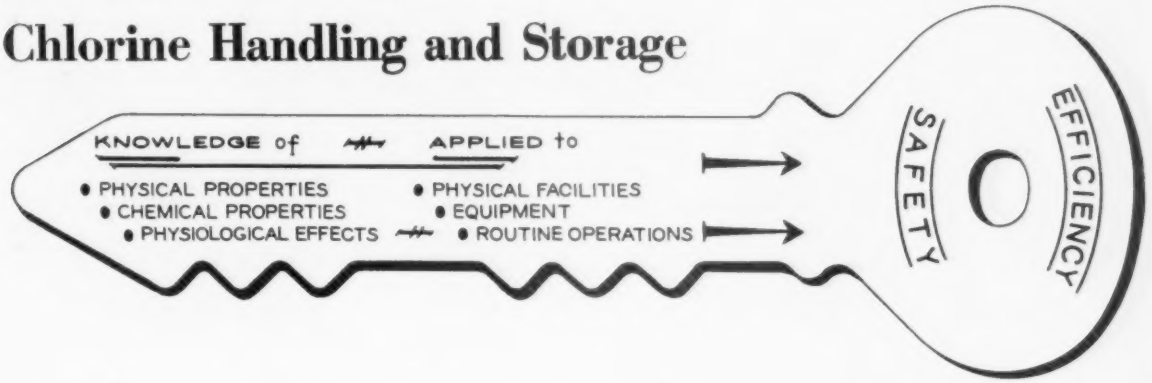
(2) Water Works Engineering, *111* No. 3, 230 (1958).



CHLORINATION GUIDE

THE KEY to safe and effective chlorination practices is knowledge properly applied. From this third of six articles may be gained knowledge on . . .

Chlorine Handling and Storage



by EDMUND J. LAUBUSCH, Sanitary Engineer
The Chlorine Institute, Inc.,* New York, N. Y.

EDITOR'S NOTE: In the previous two articles in this series, the author has reviewed the fundamental principles of the chlorination processes as they relate to conventional water and wastewater treatment practices. This article delineates, in a practcial way, safe and effective handling techniques, using equipment evolved from the advancement of the chlorination treatment processes.

■ CONSIDERATION is given in the following discussion to several important physical and chemical characteristics of chlorine that relate to its safe handling and use. Basic built-in safety devices common to all chlorine containers are reviewed and additional design recommendations are highlighted based on the experiences of a number of producers and users of chlorine. Although certain situations may warrant modified or additional procedures, the following are fundamental to the operation of most chlorination facilities. The reader is referred to the *Chlorine Manual*[1] and similar documents for more detailed information.

Chlorine Containers

Liquid chlorine is packaged in steel pressure vessels of several sizes, all of which are registered with the Bureau of Explosives and subject to the Regulations and Specifications of the Interstate Commerce Commision. Loaded containers have about 12 per cent gas space at 68°F to allow for chlorine expansion at higher temperatures; this gas space becomes completely filled with liquid when the temperature exceeds approximately 158°F. Safety devices are provided on all containers.

In the sanitary engineering field 100- and 150-lb cylinders, one-ton containers (net), or tank cars usually are employed, the choice depending on chlorine requirements and other factors. All containers are intended for use by the consumer in delivering chlorine to process; intermediate, stationary storage is provided at a few locations, but the practice currently is not recommended for general use.[2,3]

Cylinders and Ton Containers. Fusible plug safety devices are provided on all cylinders and ton containers. They are designed to melt or soften between 158°F and 165° to preclude a build-up of hydrostatic pressure resulting from thermal expansion due to fire or other hazardous conditions. In the case of cylinders the fusible plug is part of the Chlorine Institute standard cylinder valve, and is located below the valve seat independent of the valve control (Fig. III-1). Ton containers are provided with six, larger plugs, three located at each end but *not* part of either the gas or liquid discharge valves (Fig. III-2). These safety devices should never be tampered with under any circumstances.

Tank Cars. Welded steel tank cars —16-, 30- or 55-ton capacity—(Fig. III-3) have a special safety valve which consists of a breaking pin assembly and a spring-loaded safety valve. The safety valve is set to re-

*The Institute and its members make no guarantee of results and assume no liability, jointly or severally, in connection with the information herein contained or the safety suggestions herein made.

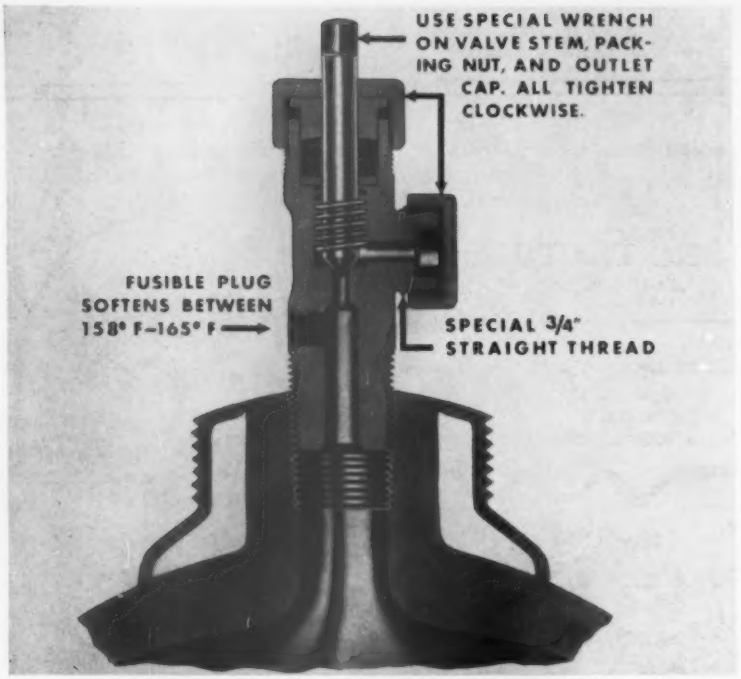

USE SPECIAL WRENCH ON VALVE STEM, PACKING NUT, AND OUTLET CAP. ALL TIGHTEN CLOCKWISE.
FUSIBLE PLUG SOFTENS BETWEEN 158° F–165° F
SPECIAL 3/4" STRAIGHT THREAD

FIG. III—1. STANDARD cylinder valve of Chlorine Institute with a poured fusible metal plug. Valves with screwed type plugs are also available. The Chlorine Institute ton container valve is similar but sometimes has a larger internal hole and contains no fusible plug.

lieve at 375 psig or 225 psig for cars registered to ICC Specification 105A500 or 105A300, respectively. (The relieving pressure is stenciled on the car.) This safety valve and four angle valves are the only connections on the car, and all are located in the car dome.

The two angle valves on the longitudinal axis of the car discharge liquid chlorine. Under these valves there are education pipes extending to the bottom of the tank, each having a rising ball excess flow valve designed to close when the rate of discharge exceeds about 8000 lb/hr such as might occur, for example, if the liquid discharge line should accidentally be broken. At right angles to these valves, perpendicular to the longitudinal axis, there are two additional angle valves for discharge of chlorine gas (Fig. III-4). All angle valve outlets have one-inch, American standard taper female pipe threads protected by one-inch plugs. (Fig. III-5) These plugs should always remain in place until connection is made and should be replaced immediately upon disconnecting the pipe line in order to prevent moisture from entering the valve and promoting serious corrosion.

Multiple Unit Cars. The TMU, or multiple unit tank car (Fig. III-6), consists of an underframe carrying 15 one-ton containers. It is especially suitable for installations where chlorine requirements are substantial and where more flexibility than that afforded by single unit tank cars is required.

Transfer and Storage

Shipping and Moving. Cylinders of chlorine may be shipped in any amount by motor and rail carriers but they almost invariably are received at water and sewage treatment plants by truck. In transit, cylinders should be positioned upright and securely fastened; ton containers should be fastened securely on a suitable rack, or other means should be provided to prevent rolling. If cylinders are to be unloaded from a truck to ground level it is good practice to have available a hydraulic lift gate or suitable skid with a rubber bumper at the bottom. Suitable hoists having a capacity of not less than two tons and fitted with a specially designed lifting bar (Fig. III-7) should be provided for unloading and handling of one-ton containers.

A suitable hand truck should be available for moving chlorine cylinders, and cylinders should be securely fastened thereon (Fig. III-8) at all times. Hoisting should be avoided as much as possible but, where necessary, a suitable lifting device should be provided.

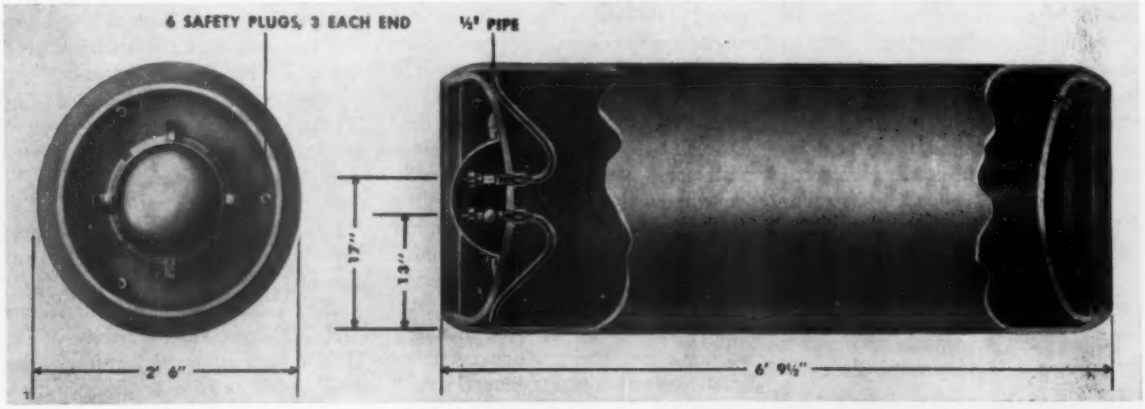
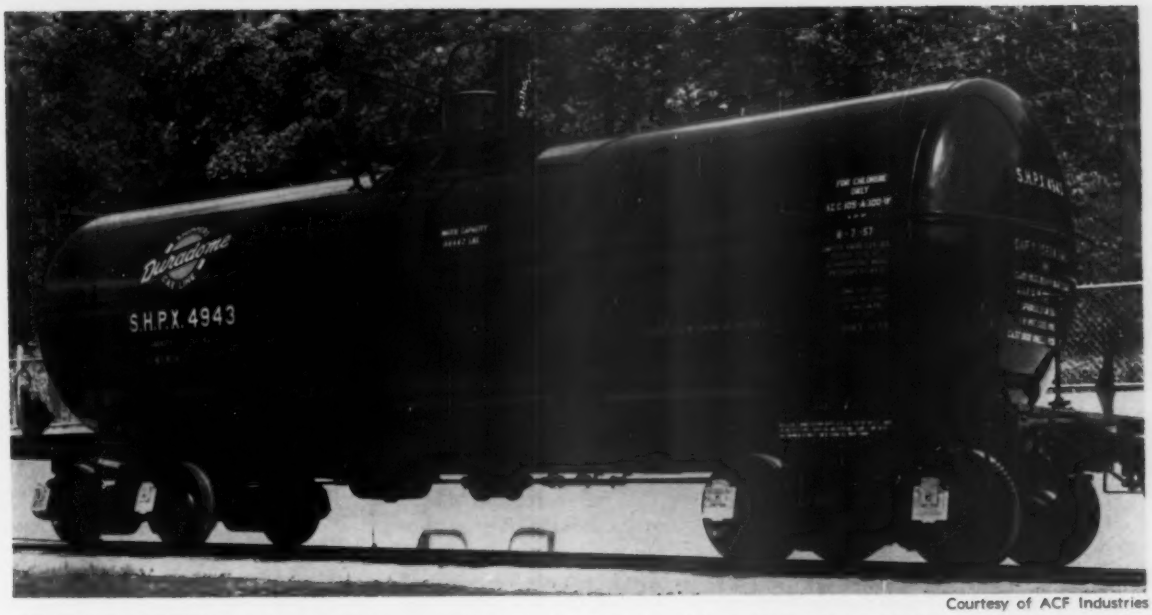


FIG. III—2. CHLORINE ton container, equipped with two valves connected to eduction pipes to permit either gas or liquid withdrawal. Note the location of the fusible metal safety plugs.



Courtesy of ACF Industries

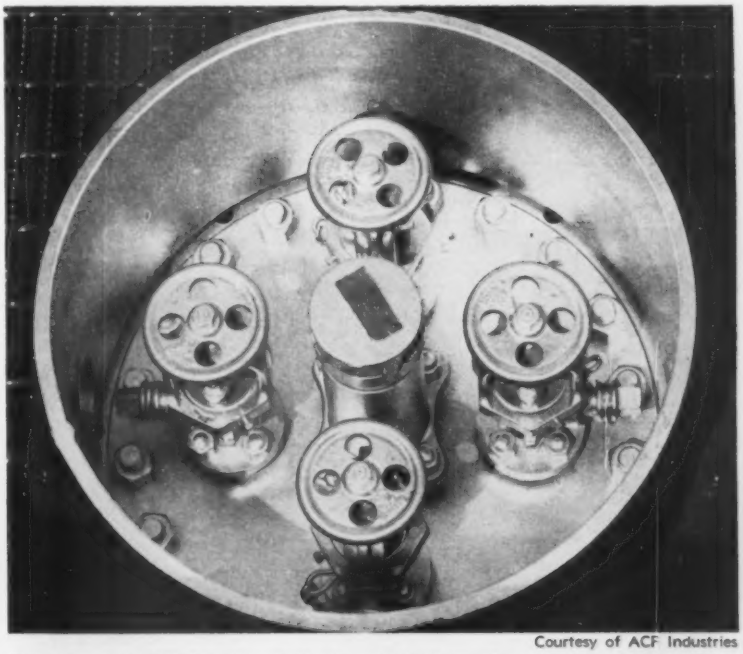
FIG. III—3. CHLORINE tank car, 55 ton capacity is made of steel and is protected by a 4-inch cork insulation and an outer steel shell.

Multiple unit tank cars can be consigned to an approved public railroad siding remote from the point of use and the containers trucked to their final destination. Single unit tank cars, however, may be consigned only to privately-owned or leased sidings.

Storing. Chlorine cylinders preferably should be stored in an upright position and so arranged that, in an emergency, a leaking container can be removed with the least possible handling of others. Ton containers should be stored on their sides at all times; they should rest securely on cradles or on a level rack equipped with adequate safety blocks to prevent rolling and slightly elevated from the floor to keep them dry (Fig. III-9).

Cylinders and ton containers always should be stored in a cool, well-ventilated area, protected against external heat sources. Good housekeeping should be observed in the storage area. If stored outdoors, protection from precipitation, direct sunlight, and other damaging influences should be provided. It is preferable to provide for separate storage of full and empty cylinders and ton containers and, except when in actual use, valve protection hoods always should be kept in place.

Chlorine storage and feeding areas preferably should be located above ground level, well ventilated, and of fire-resistant construction. For large installations, sub-surface installations, and in buildings occupied by persons or housing equipment subject to chlorine attack, a separate and reasonably gas-tight enclosure opening to the outdoors should be provided for housing the chlorine feeding equipment. The enclosure should be vented to the upper atmosphere and equipped with positive means of exhaust (near floor level, at the center of the room or opposite the entrance) capable of a complete air change within 2 to 3 min-



Courtesy of ACF Industries

FIG. III—4. DOME interior of single unit tank car for chlorine. The safety valve in center is surrounded by four angle valves for chlorine discharge. Check valves are located in eduction pipes under each of the two (liquid) angle valves along the longitudinal axis of the car.

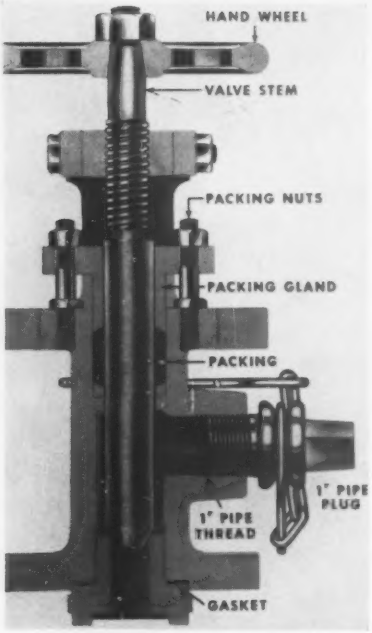


FIG. III—5. STANDARD chlorine angle valve for single unit tank cars.

utes. The actuating switch should be located immediately outside the entrance, and it is good practice always to effect a complete change of air before entering. A satisfactory ventilation scheme involves a combination fresh-air and exhaust system consisting of fans that force fresh air into the enclosure through openings near the ceiling and other fans that can exhaust any chlorine-contaminated air near floor level. The system should always be completely independent of any other ventilation system on the location.

Using

Facilities should be designed and operated to minimize all hazards associated with connecting, emptying and disconnecting chlorine containers. These operations should be performed only in well-lighted places by authorized personnel equipped with gas masks or other suitable respiratory protective devices. Whether discharge is in the liquid or gas state, the containers, discharge valves, and piping should be so located to avoid fracture from impact with heavy objects. Container valves should not be left opened when operating personnel are not immediately available at the plant. Recommendations more detailed than those that follow are available.[1,4]

Emptying Containers. Higher temperatures on chlorine containers than on chlorine gas pipe lines or chlorine feeders will cause liquefaction in the cooler portions of the line or in the chlorine feeder. Where possible, provision should be made for emptying containers in areas of about equal or slightly higher temperature to that in which they are stored (approximately 70°F-80°F preferred. A pressure reducing valve near the container may be necessary where it is not possible to obtain suitable temperature conditions. Similarly, provision should be made to keep liquid chlorine lines at a temperature somewhat lower than that existing at the chlorine source.

Chlorine gas is discharged from cylinders in an upright position; liquid chlorine is discharged from inverted chlorine cylinders but the latter practice is neither common nor recommended. Ton containers can be emptied in either the liquid or gaseous state. The container units always should be positioned so that the two valves are in a vertical plane; in this position, the upper valve discharge chlorine gas and the lower valve discharges liquid chlorine.

The maximum withdrawal rate of chlorine gas at 70°F approximates 40 lb/day for 100- and 150-lb cylinders, and 450 lb/day for ton containers. (Gas withdrawal from ton containers seldom is practiced.) The rate of discharge of liquid chlorine is considerably greater than that obtainable when discharging chlorine gas. Under no circumstances should heat be applied to any chlorine container to increase the withdrawal rate.

Manifold systems can be used to connect two or more chlorine cylinders or ton containers where the maximum chlorine feed rate exceeds the maximum continuous withdrawal rate from a single unit (Fig. III-10). When used, special safety precautions should be observed and the temperature of all manifold containers must be uniform. Liquid chlorine lines never should be manifolded.

The rate of discharge of liquid chlorine from tank cars depends on the tank car vapor pressure and temperature of liquid chlorine, and is limited by the excess flow valves to about 8000 lb/hr per valve. In general, unless an exceedingly high rate of flow is required, where the chlorine must be raised to an abnormal elevation, or where the air temperature is low, the car pressure ordinarily will pro-

Courtesy of Solvay Process Div., Allied Chem. Corp.

FIG. III—6. MULTIPLE unit tank car (TMU) for carrying 15 one ton chlorine containers. This type of delivery unit is available from all chlorine manufacturers.

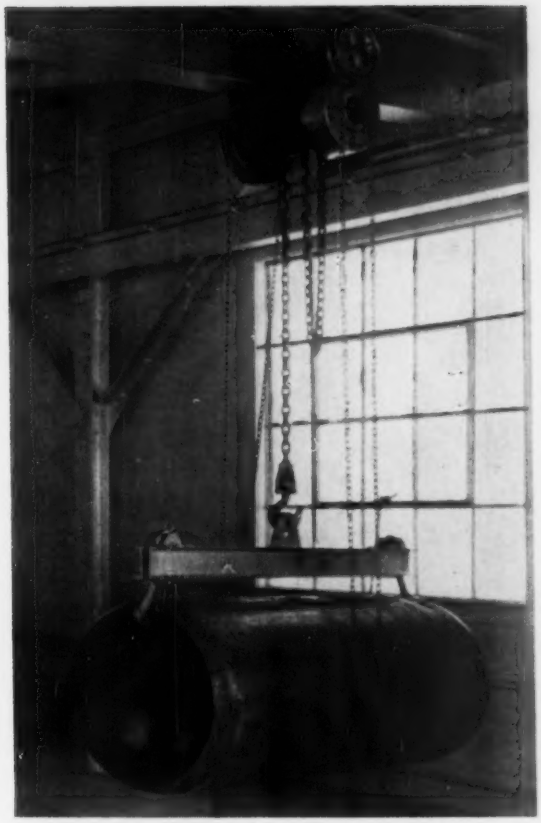


FIG. III—7. HOIST and lighting bar assembly for handling chlorine ton containers.

FIG. III—8. HAND TRUCK for moving chlorine cylinders. Note strap to secure cylinder during movement.

vide an adequate flow. Oil-free, thoroughly-dried, clean compressed air may be applied to the tank car to increase the discharge rate if necessary, or the car can be delivered with this padding provided. Special precautions must be observed by consumers who supply their own padding, and only a separate compressed air system should be used for this purpose. Recommendations concerning this operation are available from the Chlorine Institute.

Scales, preferably of the indicating type (Fig. III-10) should be provided for weighing the chlorine to ascertain the amount of chlorine remaining in containers at any time. The weight loss should be observed frequently, especially when approaching the point where the container is nearly empty. Chlorine gas pressure gages do *not* measure the volume or weight of chlorine remaining but merely indicate the probability of lowered tank contents. (Pressure exerted from confined chlorine gas is a function of temperature and, theoretically, one lb of chlorine will exert the same pressure as will 2,000 lb at any given temperature.) Evidence of a vacuum break, caused by lowering of pressure in the chlorine supply system, also might provide advance warning of depletion of the chlorine supply.

Connecting and Disconnecting. Connections to valve outlets on cylinders and ton containers can be made by either a clamp-and-adapter or a union connector. The clamp-and-adapter connection (Fig. III-11) is preferred. In making connections it should be ascertained that the outlet valve is closed

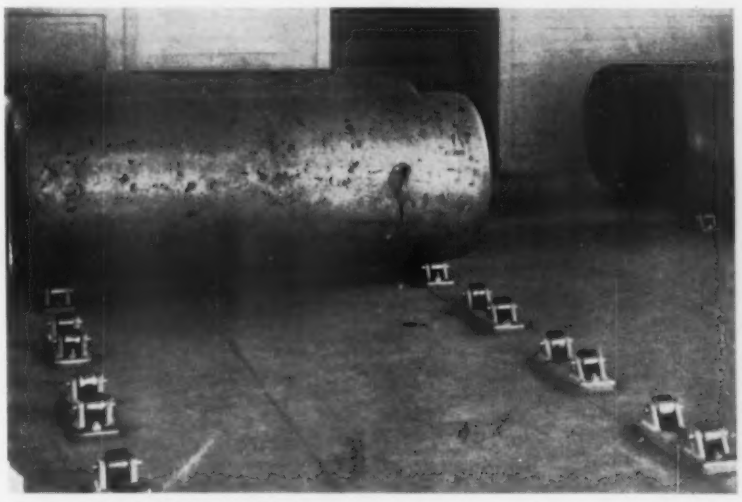


FIG. III—9. STORAGE of chlorine ton containers on cradles prevents rolling and elevates the container slightly from the floor.

FIG. III—10. INDICATING scale for ascertaining cylinder contents and checking chlorine feed. Recession of platform eliminates cylinder lifting. Note cylinder manifolding and slope of flexible chlorine discharge line from cylinders.

before the outlet cap is (slowly) removed. Gasket surfaces should be thoroughly inspected and cleaned and a new gasket of standard material should be used. All chlorine cylinder and ton container valve outlets are the same and conform to American standard B57.1. Outlet threads on such valves are *not* taper pipe threads. Connections that do not fit should never be forced.

Cylinder and ton container valves should be opened *slowly* using a special wrench no longer than 6 inches for this purpose. One complete turn of the stem in a counter-clockwise direction opens the valve sufficiently to permit maximum discharge. An auxiliary cylinder or ton container valve (Fig. III-11) should be installed adjacent to the container valve between it and the chlorine feeder or gas header on manifolded systems. Such a valve serves as an emergency shut-off should the container valve leak. Moreover, it prevents chlorine gas from escaping from the supply line when the container is removed from service. In the interests of safety, the ventilation system should be operating whenever containers are being placed into or removed from service, and at all times when an emergency exists or adjustments and repairs are being made.

FIG. III—11. CLAMP-AND-ADAPTER or yoke connection of auxiliary cylinder valve. Note flexible tubing.

Tank car angle valves should be connected and disconnected (Fig. III-12) using a pipe wrench no longer than 18 inches. In discontinuing the flow of liquid chlorine from tank cars (and ton containers) the supply line to the evaporator should be emptied since expansion of any remaining chlorine may build up hydrostatic pressure and burst the line. The tank car angle valve (or lower ton container valve) should be closed first and the line evacuated by continuing the use of any chlorine remaining before the evaporator inlet valve is closed.

All containers should be tested for leaks when being placed into or removed from service. If a leak is evident around the valve stem and all other precautions have been observed, it usually can be eliminated by tightening the packing nut. Chlorine leaks *always* get worse; help should be solicted if they are serious and they can not readily be eliminated. (These matters are discussed in detail in the next article of this series.)

Other Appurtenances

Piping Systems. Chlorine can contribute to the corrosion of a system to which it is introduced. Dry chlorine, either liquid or gas, is not corrosive to steel or other common metals (except aluminum) at temperatures below 300°F. In the presence of even minute quantities of moisture, chlorine is highly corrosive. Accordingly, pipe lines, valves, containers and other equipment through which dry chlorine passes should be tightly closed when not in use to preclude the introduction of moisture from the air.

Dry chlorine gas or liquid under pressure should be handled in extra heavy wrought iron or steel pipe, or in flexible, annealed copper tubing suitable for 500 lb working pressure.

A flexible arrangement should be provided on the discharge line from the chlorine container and the piping should slope upward from the chlorine source, especially when discharging in the liquid state. Long piping lines should be avoided.

Moist chlorine is extremely corrosive and can not be handled in pipe or tubing of the same construction used for dry chlorine gas. For low-pressure conduction of moist chlorine gas or for aqueous solutions of chlorine, hard rubber, Saran-lined, rubber-lined, polyethylene, or Uscolite piping should be used. For higher pressures, materials such as silver, platinum or Hastelloy "C" should be used.

It is important to observe the correct temperature conditions in conducting chlorine from the source to the point of use. To prevent reliquefaction of gas, such piping systems and control equipment should be in an area at an equal or a higher temperature than that of the chlorine container. It is preferable to locate chlorine gas lines overhead through relatively warm areas than along the floor or in other areas where low temperatures may be encountered. For liquid chlorine piping systems, conditions which contribute to vaporization should be avoided. Lines should be as cool as or cooler than the chlorine containers and they should not be located in overheated areas where vaporization might occur.

For one and one-half inch pipe and smaller, connections may be either screwed, welded or flanged. If flanged, facing should be small tongue-and-groove. Gaskets should be 2-3 per cent antimony lead or asbestos sheet conforming to Specification MIL-A-1472; rubber gaskets are not suitable. Screwed fittings should be 3000-lb forged-steel construction.

Valves may be necessary at various points in chlorine piping systems to isolate sections of the system, to regulate pressure conditions, or to stop the flow of chlorine gas to a feeder when several are directly connected to the same chlorine supply. Valves should be drop-forged steel of a type specifically designed for chlorine service. (The Chlorine Institute standard ton container valve is useful in many situations.) While essential at many points, their use should be held to a minimum, especially on liquid chlorine systems.

FIG. III—12. CONNECTNG chlorine tank car. Note flexible discharge line and special wrenches.

Evaporators and Feeders, Etc. Various types of evaporators and chlorine gas feeders are used at sanitary engineering installations and these will be discussed in detail in a later article in this series. Equipment should have sufficient capacity to exceed the highest expected demand at any time and to provide continuous, effective treatment under all prevailing hydraulic conditions. Duplicate equipment should be provided for disinfection and other essential treatment processes. Where this is not feasible a complete stock of spare parts and tools should be maintained for emergency replacements or repairs. For normal operation, emergency or stand-by equipment should not be depended upon to meet the chlorine demand or to satisfy chlorine requirements for the treatment employed. A reliable, uninterrupted supply of water, free of coarse suspended matter, should be available under adequate pressure to assure the continuous operation of solution-feed equipment. Hydraulically- or electrically-driven equipment, if needed to maintain a satisfactory working pressure, should be provided with alternate power sources.

Although chlorine is marketed in remarkably pure form (the concentration of impurities being far less than that which can be detected by ordinary assay procedures), various reports indicate that certain operating difficulties have occurred at some installations. Many of these are presumed to be caused by the occasional presence of minute concentrations of impurities in commercial liquid chlorine.* Although silicon halides, hexachloroethane, ferric chloride, carbon tetrachloride and others have been cited from time to time, the actual cause (s) of such difficulties has not been established. Moreover, limiting impurities concentrations have not been defined either alone or in possible cumulative or synergistic forms. Some research currently is under way from which it is hoped that qualitative and quantitative performance criteria might be defined. Meanwhile a program of routine inspection and maintenance of chlorine feeding equipment is recommended to minimize operating problems believed to be associated with commodity quality.

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(4) Joint Committee Report. Recommended Procedures in the Use of Chlorine at Water and Sewage Plants. *J.A.W.W.A.*, 45:10 (Oct. 1953).

(5) Am. Water Works Assn. Inc. Tentative AWWA Standard for Liquid Chlorine, B301-57T. *J.A.W.W.A.*, 50:2 (Feb. 1958).

*The American Water Works Association recently published a tentative specification for liquid chlorine which limits the combined concentrations of all impurities to 0.5 per cent in accord with Federal practice[5]. Chlorine producers currently furnish a water works grade of chlorine of comparable or better quality.

Termination of television programs produces a direct effect on . . .

Water System Operation

by R. L. BROWN, San. Engr., Black & Veatch, Consulting Engineers, Kansas City, Mo.

■ IN CONNECTION WITH A water distribution analysis for Wichita, Kansas, a study of the recording charts indicated pronounced variations in pressure and pumpage during the evenings, usually at regular hour and half hour intervals. An exhaustive investigation was not made, but it seems reasonable to assume that these variations are related to the termination of television programs.

Since the physiological make-up and natural urges of people are basically the same the world over, the effects noted at Wichita must be occurring in other water systems in all areas within the range of television.

Reproduced below is a recording pressure chart showing the water pressure variations in feet of head for the 24-hour period from 8:00 A.M. March 26, 1958 to 8:00 A.M. March 27th in a 24-inch water main located in a residential area.

Pressure Chart Provides Proof

By an inspection of this chart it will be noted that a marked drop in pressure occurred at 11:15 P.M. It can hardly be considered a coincidence that the more than two hour long Academy Award television program was concluded at this same time.

A chart recording the water depth in a 2 million gallon elevated tank more than one mile further north was also studied. This showed a drop of one foot in the water depth in the tank between 11:15 and 11:20 P.M. During this five minute period water was being discharged from the tank into the distribution system at a rate of 18 million gallons per day.

The pressure drop occurring at 12:45 A.M. on the chart here reproduced is known to have been caused by shutting down one pump at the main pumping station supplying the distribution system. Other pressure drops on the hour and half hour are indicated on this chart prior to the end of the Academy Award program. They no doubt relate to the termination of other television programs. No attempt has been made to pin-point these to specific programs, although it is probable that the pressure drop occurring at 5:40 P.M. was caused by a lull in the Mickey Mouse program.

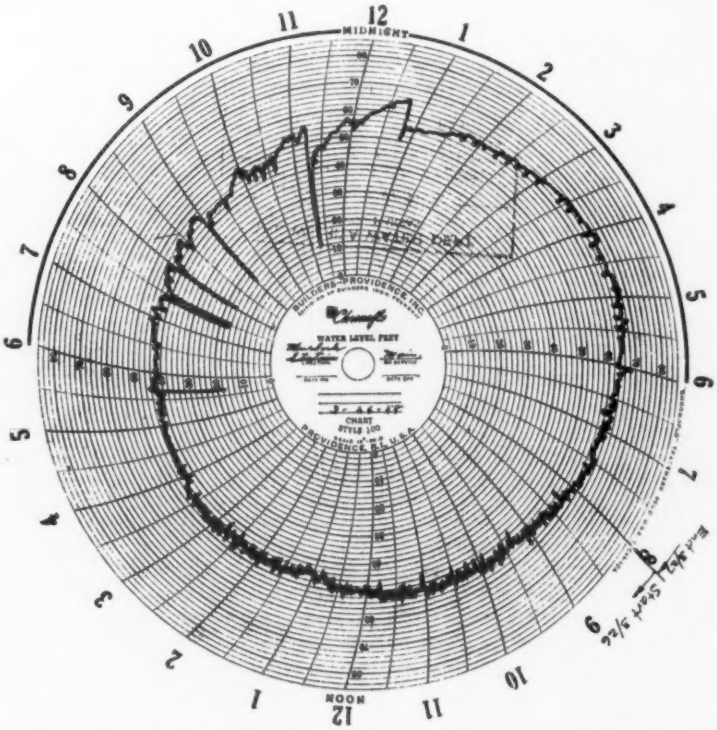
Possible Commercial Use of Charts

Water departments might consider the possibility of augmenting regular revenue by furnishing on a fee basis copies of the daily pressure charts to one of the commercial television polling agenies for use in evaluating the audience appeal of individual television programs.

For the water distribution study now in progress, it is not contemplated that it will be necessary to undertake a statistical analysis to determine the most probable number (MPN) of bathrooms which must have been in simultaneous use at the conclusion of the Academy Award program.

Programming Water Use

With the increased popularity of television, it is possible that it may be necessary for cities to institute a plan for programming the use of bathroom facilities at the end of evening TV programs to prevent the occurrence of short periods of seriously low pressure in the water distribution system.



PRESSURE IN FEET in 24 in. water main in Wichita, Kansas, covering period March 26-27, 1958.

An understanding of the how and why of the . . .

Mechanism of Corrosion *may explain problems*

by ARTHUR G. KELLER,
Professor, Dept. of Chemical Engineering,
Louisiana State University

EDITOR'S NOTE: The author reviews the basic fundamentals and uses well-known experiences to explain the mechanism of corrosion in ferrous metals.

The destruction of a metal by chemical or electrochemical reaction with its environment, defines corrosion, and the conversion of ferrous metals in contact with moisture to the oxide form (rust) is an example. The driving force or the tendency of the metal to corrode is electrochemical. The rate at which corrosion proceeds however, is largely dependent on the resistance to continued attack caused by the products of the corrosion reaction.

Modern means to duplicate this resistance such as cathodic protection, galvanizing, and the use of sacrificial anodes, are explained and discussed.

■ THE ECONOMIC COST of corrosion in this country is tremendous. About ten years ago Dr. Uhlig, an authority on corrosion, estimated that the annual cost of corrosion in the United States was of an order of $5.5 billion. This included the actual loss of material by rusting, the money spent attempting to protect equipment from rusting and money spent on the other forms of corrosion protection, such as galvanizing.

Today, corrosion is a major concern as evidenced by the increased activity in the field of corrosion control. To discuss the phenomenon of corrosion, the definitions and terms used must be understood.

Review of Fundamentals

A knowledge of the fundamental concepts of chemistry is essential to an understanding of corrosion. First, concerning the composition of matter, it is defined as anything that occupies space and has mass. All matter is composed of molecules, and all molecules are composed of atoms.

A molecule is the smallest particle into which matter can be subdivided without destroying its characteristic properties. The atom, until recent times, has been thought to be solid and indivisible. The smallest part of a molecule, the atom, has been considered to be a unit of matter. Atoms of the same kind can combine with one another to form molecules of the same matter. Atoms of different kinds can combine to form molecules of a new kind of matter which may sometimes be referred to as compounds. We are frequently dealing with this latter type of reaction between different sorts of atoms. For example, iron may combine with oxygen to form iron oxide. Here one kind of atom, iron, combining with another kind of atom, oxygen, formed a new molecule, iron oxide.

Originally, it was assumed that the atom was the smallest particle into which matter could be divided. Later developments have indicated that this theory was incorrect and it is now assumed that the atom is actually made up of a number of distinct particles — principally charges of electricity. In the atom we normally have a *nucleus*, or center, made up of positive charges, and around this center we have revolving, very much as our earth revolves around the sun, negative electrical charges or *electrons*. Depending upon the particular kind of matter involved there may be a large number, or a small number of electrons revolving around the nucleus and they may be revolving in several orbits. When an atom loses or gains an electrical charge, it normally undergoes some type of chemical reaction. For example, when ordinary metallic iron loses an electrical charge or charges it becomes a kind of iron which we refer to as an *ion*. Matter in this condition can react readily with other types of matter and we say that the material is in the ionic condition. Normally, matter exists in the ionic condition only in the presence of water. There are exceptions to this statement. For our purposes one point should be emphasized: For most of the chemical reactions occurring in corrosion which concern us, the presence of water is an absolute essential: therefore, without water, there can be no ions and no corrosion.

Contributing Factors

In water systems the principal factors influencing corrosion of ferrous

Corrosion is an electrochemical reaction, and normally oxygen and moisture must be present for corrosion to be effective. Likewise, the elimination of oxygen or moisture from a metal surface automatically reduces its tendency to corrode.

metals are the water characteristics, temperature, rate of flow and the contact of dissimilar metals. The chief variables controlling the characteristics of the water are its dissolved oxygen content, carbon dioxide concentration, pH and dissolved solids. Other factors are involved, of course, such as the possible presence of free mineral acids, hydrogen sulphide and sulphites, carbon dioxide, etc. In addition, certain bacteria may be a factor. The presence of oxygen is usually essential for serious corosion to take place in natural water. Dissolved oxygen will greatly accelerate corrosion in acid, neutral or slightly alkaline water.

Corrosion of Iron

Corrosion of iron in water may be expressed in a simplified way by the following chemical equations:

$$(1)\quad \underset{\text{Iron}}{Fe} \rightarrow \underset{\text{Ferrous}}{Fe^{++}} + \underset{\text{Electrons}}{2e}$$

$$(2)\quad \underset{\text{Water}}{2HOH} \rightarrow \underset{\text{Hydroxyl Ions}}{2OH^-} + \underset{\text{Hydrogen Ions}}{2H^+}$$

$$(3)\quad \underset{\text{Ferrous Hydroxide}}{Fe(OH)_2} + \underset{\text{Hydrogen Atoms}}{2H}$$

In these equations plus signs have been used for positive electrical charges or ions and minus signs for negative electric charges or electrons. In equation (1), it will be noted that iron in water dissolves and because water is present, the iron which has dissolved loses two electrical charges, becomes positive and is called ferrous iron. There are two free negative electrical charges floating around. In (2), the water to which the iron is exposed breaks down to form two OH^- groups which carry one negative electrical charge each, called hydroxyl ions. In addition, there are formed two hydrogen ions each of which carries one positive charge. The total number of positive and negative charges is equal. The ferrous ion with two positive charges reacts chemically with the hydroxyl groups which have one negative charge each. The two *pluses* cancel out the two minus charges and the result is (3), a new compound ferrous hydroxide, or rust, on the one hand and hydrogen gas on the other. In this case, rusting occurred without oxygen being present. But water was present, and is an essential in the majority of corrosion reactions.

For this kind of corrosion or chemical reaction to continue there must be some way to get rid of the hydrogen gas which is formed. Rust must be removed from the surface of the iron where it has been formed. If these things are not done then eventually the reaction will stop and we say that corrosion has been inhibited or stopped.

One of the things which is essential to corrosion is the removal of one of these materials from the field of action. Now, ferrous hydroxide is not very soluble in water. Hydrogen gas likewise is not very soluble. When the water has dissolved all of the ferrous hydroxide which it can, the excess will form as a precipitate. In the case of hydrogen gas the excess will pass out as bubbles. Frequently, however, the hydrogen cannot escape. This occurs when the hydrogen is formed as an extremely thin layer on the surface of the iron. This is extremely difficult to remove. Unless removal does occur, the hydrogen covers the surface of the iron very much as a film of paint might do, and effectively stops any further chemical reaction or corrosion. It is at this place that the need for oxygen comes into play. In addition to (1) (2) (3), two additional chemical reactions may occur. These are indicated below.

$$(4)\quad \underset{\text{Hydrogen Atoms}}{2H} + \underset{\text{Dissolved Oxygen}}{\tfrac{1}{2}O_2} \rightarrow \underset{\text{Water}}{HOH}$$

$$\text{or } (5)\quad \underset{\text{Hydrogen Atoms}}{2H} \rightarrow \underset{\text{Hydrogen Gas}}{H_2}$$

The atmosphere contains about 21% oxygen gas by volume. This is dissolved quite readily in water. It is in fact almost impossible to obtain water which is completely free of oxygen. The presence of oxygen in water makes it possible for it to support aquatic life but at the same time makes it a much more corrosive medium. The first reaction shows how oxygen can make the corrosion of iron continue where otherwise it might be stopped. For example, from the initial reactions we find that ferrous hydroxide and hydrogen atoms are formed. If these hydrogen atoms cover the the iron surface they protect it and no further corrosion will take place. On the other hand if oxygen is present it will react with hydrogen atoms to form water (4) and thereby remove them and permit the reaction to proceed. In natural waters, dissolved oxygen is the controlling factor and corrosion is almost directly proportional to the oxygen content of the water.

Corrosion can occur without the formation of hydrogen gas and can be continued by the reaction of oxygen with the hydrogen, as it is formed, to produce water.

If the hydrogen is removed by other means the same result will be obtained. For example, if hydrogen or some other gas could be bubbled against the iron surface it would make it much easier for the hydrogen to get away and the second reaction (5) would occur; that is, the hydrogen atoms would combine to form a molecule of hydrogen gas which would leave the solution.

Return now to equation (2), the equation which showed how water could be decomposed into hydroxyl ions and hydrogen ions. It is the hydrogen ions which eventually form the hydrogen gas in the reaction just discussed. Attention is drawn, however, to the hydroxyl ion since it, too, plays an important part in the corrosion reaction. pH is a measure of hydrogen ion content of a solution. If the pH value is 7 or greater the solution is alkaline and if it is less than 7, the solution is acidic. It is the alkaline feature which is to be discussed now. In these reactions, when the hydrogen atoms are pro-

duced, the iron reacts with the hydroxyl iron to form ferrous hyroxide. This compound is not very soluble and will oxidize and precipitate from solution as rust. This rust will cover the surface of the iron. It will act as a protective coating and may eventually stop the corrosion reaction. A film, whether it be of hydrogen gas or of ferrous hydroxide, provided it completely covers the surface, will protect that surface from corrosion just exactly as will a very good coat of paint or lacquer.

The iron forms not one but a number of different hydroxides. The one shown in reaction (3) is very light in color and relatively soluble. This type of compound will be seen formed in water which has been drawn from a well and allowed to stand in a filled bottle. If this compound is brought into contact with more oxygen it will be oxidized to a slightly different compound called ferric hydroxide which has a red color. This is the more insoluble compound and the one which normally appears on iron surfaces as rust.

Electrochemical Reaction

Corrosion is an electrochemical reaction. The features of an electrochemical reaction are best explained using a boyhood experiment in which a strip of copper and a strip of zinc are placed in a container of dilute hydrochloric acid. A wire attached to each piece of metal will produce an electric current. This operation is a galvanic cell. As a result of the chemical reaction electricity was produced. The combination of these metals caused an electrochemical reaction. In this particular reaction one of the metals, the zinc, is dissolved in the acid and hydrogen gas is liberated. The other metal is relatively unaffected by the reaction and continues in service for long periods of time using up several portions of zinc for the one portion of copper. In a cell of this type, the material which reacts or corrodes, is called the *anode*. The material which does not react chemically or dissolve is called the *cathode*. In corrosion reactions the metal which corrodes is referred to as the anode in the corrosion cell and some other portion of the system is called the cathode.

Ferrous metals exposed to a solution at low pH values will be corroded. Normally, the presence of dissolved oxygen or dissolved carbon dioxide accelerates corrosion particularly in solutions which are 7.0 pH or less.

Differential Aeration

The anode-cathode concept comes into play in the corrosion of iron by water and oxygen. In the electrochemical reaction, two different metals make up a galvanic cell. This is also referred to as two metal or dissimilar metal corrosion. However, it is not necessary to have two different metals for corrosion to occur. Actually, one metal in two different concentrations of oxygen will produce a corrosion cell. This is illustrated by corrosion which has caused pitting of an iron pipe or a piece of iron plate. This type of corrosion is frequently referred to as differential aeration corrosion. Logically, one would assume that if one portion of the metal was exposed to a high concentration of oxygen and another to a low concentration of oxygen that the portion exposed to the higher oxygen concentration would corrode slowly. Strangely the reverse is true. This phenomena can be illustrated for example by laying a piece of wood or other material over a spot on a sheet of metal. If the wood is allowed to remain in place for a sufficiently long period of time, under conditions of an abundant supply of moisture and oxygen it will be noted that the area under the wood has corroded or pitted and that rust has formed around the edges of the wooden block. The spot under the block of wood acts as the anode in this particular cell while the area around the edge of the block of wood acts as the cathode. It is the anode which always corrodes and the cathode which does not corrode but receives the corrosion products. In this case, the iron which dissolved and formed a pit under the wood, traveled, by virtue of the electric current generated, away from the anode and toward the cathode. When the iron continues to dissolve, the iron hydroxide being in contact with oxygen from the air is precipitated and forms a line or circular mound of rust around the covering bit of wood or other material. Differential aeration type corrosion is very common in water lines. If, for example, a small amount of soil, a piece of gravel, a bit of cloth, or any object is allowed to remain in an iron pipe, a tank, or on a metal surface it will usually exclude oxygen from contact with the surface immediately below it. If other conditions are favorable corrosion will occur below the object causing pitting. A similar situation occurs where iron or steel pipe is driven into water as a support for a dock or a similar type installation. In such cases it will usually be noted that the iron does not corrode at the water's edge but corrodes at a point a few inches below the surface of the water. This is another and very common illustration of corrosion caused by differential aeration. This is an electrochemical type reaction but all of the reaction occurs with a single metal.

Stress Corrosion

Corrosion because of differences existing on the surface of the same piece of metal can be illustrated further. Where steel pipes or steel plates are welded together and the weld is not subsequently stress relieved, it will frequently be noted that severe corrosion occurs at the weld. This is usually designated as stress corosion. The explanation for this type of corrosion is simply that during the welding operation the physical condition of the iron was changed without changing its chemical composition. The iron in the area of the weld is different physically from the iron, say, 8 inches away from the weld. In the majority of such cases the iron at the weld is the anode in an electrochemical cell and the balance of the pipe is the cathode. If this pipe (and weld) is exposed to moisture and oxygen, corrosion will occur usually at the weld. Frequently failure will occur because of the differences in the metal as a result of the welding operation. The operations known as normalizing, stress relieving, etc., are normally intended to overcome this difficulty.

Acidity — Alkalinity

The pH value of the water to which iron is exposed has a very powerful effect on the rate of corrosion. At pH values below 4.3 the controlling factor in corrosion is pH. The hydrogen

film formed is destroyed rapidly by the evolution of hydrogen as a gas. In this range, too, the metal ions entering the solution remain soluble and no insoluble reaction product results. In the absence of a barrier, or protective film the corrosion rate in acid solutions is, therefore, quite high. When the solution contains dissolved oxygen in addition to a pH value in the low range mentioned, the rate of corrosion is further accelerated.

At pH values above approximately 9.5, the alkalinity increases and the pH or hydrogen ion activity decreases. The reaction illustrated earlier between iron and hydrogen ions is retarded. In addition, the red coating formed in alkaline solutions is more protective than the one formed in neutral solutions, and the rate of corrosion is appreciably decreased. In fact, a hydrogen type corrosion will not take place at normal temperatures in the absence of dissolved oxygen. However, in the presence of dissolved oxygen, the rate at which hydrogen can be removed is the controlling factor. While the rate of corrosion will be appreciably decreased a serious amount can still result. At pH values between 4.5 and 9.5 the presence of dissolved oxygen plays a more important role than pH value.

Practically all natural water contains small amounts of dissolved carbon dioxide. This is present in the atmosphere to the extent of about 0.04% by volume. It is quite soluble in water at ordinary temperatures and in consequence will practically always be found in water to a greater or lesser degree. Carbon dioxide combines with the water to form carbonic acid. This is one of the constituents which makes carbonated beverages appeal to the palate. It also promotes the formation of hydrogen ions, and water containing carbon dioxide will usually be acidic, and in the pH range of 3.5 to 5.5. Even where dissolved oxygen is not present the carbon dioxide will make the water corrosive to iron. This effect is not too serious at ordinary temperatures but can be the source of considerable damage at elevated temperatures such as prevail in steam boilers. Here great care must be used in removing all traces of carbon dioxide and oxygen from the boiler feed water to prevent corrosion of the steam tubes and other parts of the equipment.

The chemical reactions which are shown below illustrate what happens when water containing carbon dioxide comes in contact with iron.

$$\underset{\text{Carbon Dioxide}}{CO_2} + \underset{\text{Water}}{H_2O} \rightarrow \underset{\text{Carbonic Acid}}{H_2CO_3}$$

$$2\,H_2CO_3 \rightarrow \underset{\text{Hydrogen Ion}}{2H^+} + \underset{\text{Bicarbonate Ion}}{2HCO_3^-}$$

$$+ \qquad\qquad +$$

$$Fe \rightarrow 2e \quad + \quad Fe^{++}$$

$$\downarrow \qquad\qquad \downarrow$$

$$\underset{\text{Atomic Hydrogen}}{2H} \quad + \quad \underset{\text{Iron Bicarbonate}}{Fe(HCO_3)_2}$$

The carbon dioxide first reacts with the water to form carbonic acid which subsequently decomposes to produce hydrogen ion and bicarbonate ions as indicated. The iron meanwhile has produced two electrons and one ferrous ion. A reaction ensues and as a result we have atomic hydrogen coating the surface of the iron and the compound iron bicarbonate formed in solution. Since the iron bicarbonate is soluble it stays in solution and the corrosion proceeds as fast as the hydrogen is removed. The higher the pH of the solution the more difficult it is to remove the hydrogen as a gas and the slower will be the corrosion reaction. If any oxygen is present it will react with the ferrous bicarbonate to precipitate it. Normally, this material will be deposited on the surface of the metal and act to inhibit the rate of corrosion.

Protection

Aluminum and Chromium Coatings

Several times, it has been mentioned that the formation of any type of protective coating over the surface of the iron will reduce the rate of corrosion and may completely stop it. The best protection against corrosion is the formation of some type of film on the surface of the metal which will not be attacked by water or oxygen. The principal reason that aluminum has found such wide use is because of this peculiar ability it has. The same reason explains the extensive use of chrome trim on automobiles and many types of home furnishings. In the case of both aluminum and chromium the metals are very reactive and are attacked easily by oxygen in the air. The chromium oxide or the aluminum oxide which are formed are both colorless and transparent compounds. They also stick very tightly to the surface of the metal. As a result as soon as corrosion has started a film is formed which prevents oxygen and moisture from reaching the surface of the metal and therefore stops the corrosion. If this were not the case it would be impossible to use aluminum in cooking utensils and in many other common applications. The same explanation holds for the chrome trim on automobile parts.

The chromium oxide which is formed is a very effective protection of the surface against corrosion. Since films are so effective in stopping corrosion the question naturally arises, if the metal does not form its own film can we artificially produce a film for it.

Inhibiting Compounds

Inhibitors are materials which can be added to water, solutions, etc., to prevent corrosion of the metal. Unfortunately, for most purposes inhibitors are not too satisfactory because they are usually organic compounds of a toxic nature which would render water supplies impotable. A wide variety of materials can be utilized as inhibitors to prevent the attack of iron by acid or by acidic waters. One of those which has been suggested is cabbage juice. Glue is reasonably effective for the same purpose. Very high efficiency has been achieved in this field by the use of complex organic compounds which give extremely effective protection of metal surfaces against attack by strong acids such as hydrochloric. The practice of acidizing oil wells is possible because of an inhibitor which will prevent the acid from attacking the surface of the iron and yet not render it ineffective so far as the lime rock formation is concerned. These inhibitors function very much as do the films previously mentioned. The inhibitor spreads itself over the surface

Corrosion can be effectively stopped if the corrosion reaction results in the covering of the anode or cathode surface with a protective film.

as will a film of paint and prevents oxygen, water and other corrosive materials from reaching the metal surface. The film has a number of weaknesses, however.

A film to be effective must cover the surface completely if it is the surface which is being attacked, that is, the anode. If any portion of the surface is not covered then the attack will be concentrated at that point and we have pitting. If the surface in question is the cathode then protection does not have to be so complete to reduce the corrosion rate substantially. The use of chromate inhibitors in refrigeration systems and the addition of small amounts of potassium chromate to brine solutions are examples of inhibitors used to reduce the corrosivity of solutions on metal equipment.

Effect of Temperature

A discussion on corrosion mechanisms would not be complete without reference to the effect of temperature on its reactions. It is a rule of thumb in chemistry that an increase of 10°C or 18°F will double the rate at which a chemical reaction proceeds. This is another way of saying that chemical reactions slow down as the temperature drops and speed up as the temperature rises. Reactions which are not harmful at ordinary room temperature can be very serious at the temperature of boiling water.

A temperature effect which is unusual but quite easily explained is that of corrosion because of differences in temperature at two points on a metal surface. The hotter section will usually be anodic toward the section of the metal at a lower temperature which is the cathode. Thus, on a pipe or plate which is at two different temperatures, the part at the highest temperature will usually corrode while the cooler section will not. This statement assumes that both sections will be exposed to the same atmosphere using a solution of some type.

Velocity of Flowing Liquid

Corrosion increases as the velocity with which the liquid flows by a point increases. The increase in corrosion with increase in velocity of water in a line is usually explained as due to the increased amount of oxygen which is made available per unit time at the higher flow rates and the more rapid removal of hydrogen by the same mechanism. Generally, there is a very rapid increase in corrosion rate as flow rate increases from about 1 foot per second up to about 4 feet per second. At higher rates the increase in corrosion is not so pronounced.

Corrosion protection may be obtained through the use of sacrificial anodes. A metal above iron in the Electromotive Series connected electrically to the iron surface will be corroded or serve as an anode and thereby prevent the iron from being attacked.

Dissimilar Metals

Corrosion frequently occurs to a very serious extent when two dissimilar metals are brought into contact. This is frequently noted where the threads of a steel pipe rust out at the point of entrance to a bronze valve. This type of corrosion is usually known as galvanic or two metal corrosion. The various metals which are available have been listed according to their tendency to corrode or to dissolve. This listing is referred to as the Electromotive Series of Metals. The most reactive metals are those which are normally not suitable for construction purposes. Such metals as sodium and potassium are very high on the list on the Electromotive Series and for that reason cannot be used in contact with water. The metals at the bottom of the list are those which are relatively non-corrosive, such as, platinum and gold. Iron occupies a position about mid-way in the series. An interesting thing about this series is that any metal which is above another metal in the series will be anodic toward that metal. Iron, for example, is above copper in the Electromotive Series. If iron and copper are brought in contact with one another in the presence of water, the iron will be the anode and will dissolve. The copper will be the cathode and will be unaffected. Generally, in a system in which a corrosive material is being handled it is extremely important to know your metals and know which metals will be attacked and which will not be attacked. In such cases it is wise to avoid having a combination of different metals in the series in contact with one another. Sometimes this fact can be used to advantage. This is the case with galvanized iron.

Cathodic Protection

Galvanized iron is iron which has been coated with a layer of zinc. Zinc is a metal which is ahead of iron in the Electromotive Series. When the two metals are in contact the zinc corrodes and the iron does not.

This is an example of cathodic protection. The iron, since it is below zinc in the electromotive series, is the cathode in the electrochemical cell while the zinc is the anode, or material which corrodes. Since the corrosion product of zinc is a white or transparent material which forms a tight adherent film, it will be appreciated that the zinc makes an excellent protecting agent for the iron sheets.

Cathodic protection has found rather wide application in certain fields. For example, most hot water heaters are provided with a bar or rod, usually of zinc, which actually protects the iron interior of the heater from corrosion and the formation of rust colored water. In a similar fashion, elevated water tanks are sometimes protected by the installation of the zinc electrodes which are attacked or dissolved and in that way prevent the iron from rusting.

It is necessary to caution against the indiscriminate use of cathodic protection. In such cases the transfer of electricity or electrons between anode and cathode is usually in a straight line. The easiest object to protect cathodically would be a length of circular pipe which could be almost ideally protected by a rod of zinc extending down the center of the pipe and equidistant from the sides. Here, the distance that the electrons would have to travel to reach any point of the iron surface would be the same so that the protection would be uniform across the surface of the iron. If the object is irregular in shape and protection is not uniform, then there is always the serious danger that one part may be protected while another part may be seriously exposed and actually caused to corrode more than would otherwise be the case. Cathodic protection has been applied to the protection of buried pipe lines, tanks of various sorts and similar applications. Each case must be carefully studied to determine the proper location of the sacrificial anode to insure complete and satisfactory protection.

Solar stills, evaporators, electrodialysis and freezing show promise of providing relatively low-cost techniques for . . .

Saline Water Conversion

by SHEPPARD T. POWELL,
Consulting Engineer, Baltimore, Md.

ED. NOTE: Mr. Powell presented this report, on various research projects currently being conducted by scientists in over 20 different countries throughout the world, before the Water and Power Resources Committee of the Los Angeles Chamber of Commerce.

■ WATER CONSUMPTION in this country has increased more than sevenfold since 1900 and it is reliably predicted that by 1975 the national water requirements will be doubled. This is a sobering prospect which cannot be ignored. Even in areas where large volumes of water are available, shortages are being experienced due largely to concentration of industries and population, and to the ever increasing demand for irrigation water.

A rational and coordinated federal and state water policy can do much to solve the country's water needs. This can be effected by a number of corrective measures, some of which if adopted, could avoid or minimize water shortages in many places. Particular reference being made to the conversion of sea water and other available saline sources into acceptble fresh water.

Over the ages, mankind has recognized that the production of fresh water from the sea offered one of the greatest economic benefits and, if accomplished successfully, would revolutionize living conditions where fresh water is now unavailable or in short supply.

Studies Being Made in 30 Countries

In recent years there has been expanding interest in methods of desalting water and at the present time studies are being actively pursued in more than 30 countries throughout the world. The first intensive and coordinated research and development program in this country was initiated in 1952, when the Congress of the United States passed Public Law 448. The purpose of this legislation was to develop low cost salt water conversion processes through research grants and contracts. To carry out the provisions of the Act, the appropriation of $2,000,000 was authorized for a five-year period. Congress designated the Secretary of the Interior to carry out the terms of the Act, and the Secretary created the Office of Saline Water to plan and conduct the program. In June, 1955, Congress extended and expanded the actively to include some work in Government laboratories and increased the total authorization to $10,000,000 over the period from 1952 to 1966. So far only $2,850,000 has actually been appropriated.

The widespread interest in desalting water is illustrated by the fact that since the Saline Water Program was initiated in 1952, there has been received more than 600 suggested schemes, all of which have been evaluated. Out of this flood of lay and technical ideas, 58 possessed sufficient scientific merit to justify the awarding of research and development contracts.

Five General Process Groups

The processes showing potential merit so far fall in five general groups, in addition to basic and exploratory research on entirely new ideas which constitutes a sixth group. Emphasis and effort are being concentrated on the ones indicating most promising results.

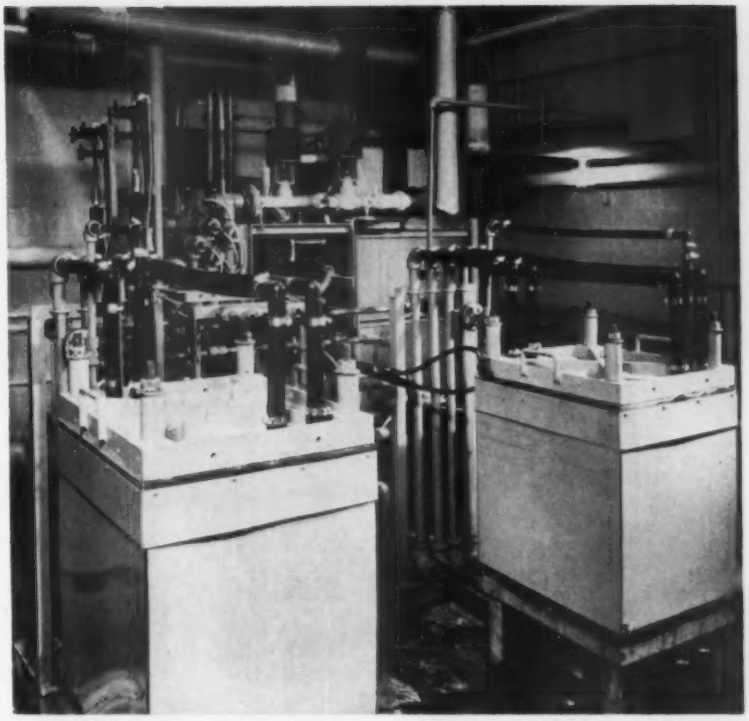
As a result of the contract work so far one pilot plant has been field tested and is in commercial production, two pilot plants are under field test in North Carolina, while a third group of smaller pilot plants is being installed. Four processes are in advanced laboratory stage and will reach pilot plant phase within the next year and several new processes are being advanced in the laboartories.

Most of the demineralization processes known are now under study or are in the experimental stage of development by scientists in at least twenty countries, in addition to the investigative projects in the United States. The five general types of conversion processes include distillation by various types of evaporators, solar distillation, freezing methods, membrane processes including osmosis and electrodialysis, and solvent extraction. Other processes under exploratory research involve complex chemical and thermodynamic reactions. The present state of practical application of distillation and the other more advanced processes indicate that much more exploratory and basic research in quest of wholly new approaches is justified if water at the low costs needed for municipal and irrigation uses is to be had.

Solar Stills

Production of fresh water from saline sources by solar stills is the simplest type of conversion apparatus. The sea water to be evaporated is run into shallow compartments and the vapor produced by the sun's rays is condensed by a cover made of glass or plastic material. The condensation, which is free of solids, is collected by appropriate troughs. This type of apparatus has application in many places in the world where there is a high percentage of sunlight during the year, and the conversion process, therefore, has some application in certain areas in the United States. This type of system has wide application where low quantities of water are required.

As with other processes, the cost of solar distillation varies greatly and some investigators believe that with further research water might be produced as low as fifty cents per thousand gallons. At present, however, costs are very much higher, probably of the magnitude of two dollars per thousand gallons, or more.



BRACKISH WATERS such as well water used at a New York Thruway restaurant near Victor has undesirable salts removed by this Ionics Inc. equipment rated at 12,000 gpd.

Electrodialysis

Conversion by electrodialysis is based on the removal of ions by passage of the water through specially prepared membranes. The mechanism by which the process functions involves complex electrochemical principles and is not subject to discussion here. Although this process can convert sea water to fresh water, it is uneconomical at present for such service, except under special conditions. Undoubtedly, the future application of such processes will be more adapted to brackish supplies than to sea water. Fairly extensive research work in this field of endeavor has been conducted by numerous groups, both in this country and abroad. It is expected that such research will be continued.

A number of small capacity plants of this type have been installed and operated successfully for several years. It has been reported recently that a large capacity system of this type has been authorized by a group in South Africa. The designed capacity of the plant will be nearly 3 million U. S. gallons daily. The source of the saline water will be water pumped from gold mining operations. It is predicted that the saline salts which are principally sodium chloride will be reduced from 4000 parts per million to 500 ppm. The estimated cost of the conversion will be about 29 cents per 1000 gallons, under the local conditions. This is a low cost treatment and, if realized, should be of interest.

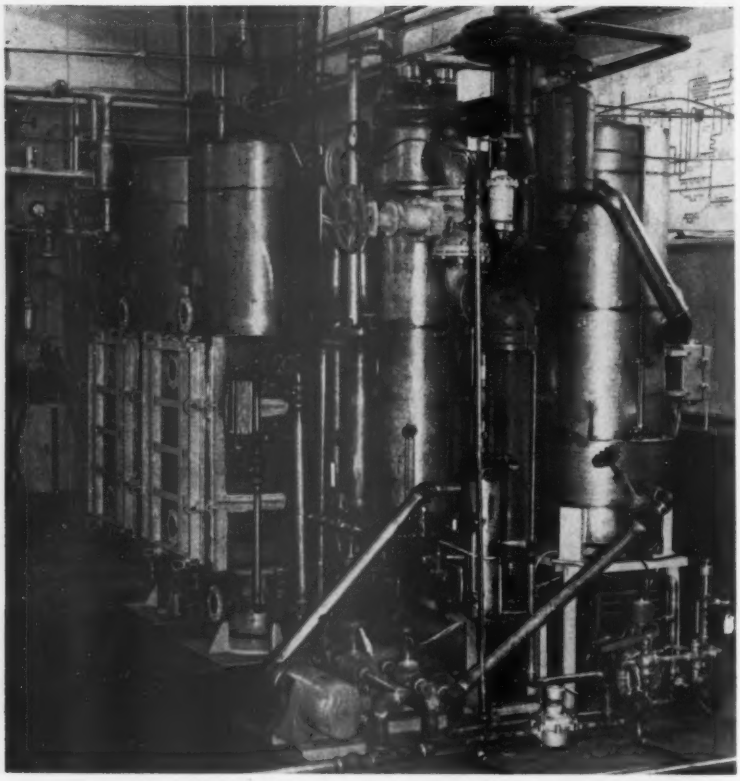
A more recent application is the small commercial unit shown in the photograph. This unit, purchased for $42,500 is expected to produce water under the local operating conditions at a cost of $0.50 per 1,000 gallons. The unit removes about 200 pounds of salts from a throughput of 12,000 gpd of water reported to be about one-fourteenth the mineral content of full-strength sea water.

Freezing

Research for desalting of sea water by the freezing method is continuing and has promise of application under specific conditions. It has been developed to a stage which should warrant a pilot plant of small capacity within a year. The process consists merely in lowering the temperature of the saline water to form ice crystals which are free from salts, subjecting the crystals to successive washings with fresh water to remove entrained salts. One investigator developing a particular freezing cycle has estimated a cost of about $1.00 per 1000 gallons of fresh water having a salt content of 500 parts per million. Comparing this figure with a predicted cost of $1.00 per 1000 gallons, or less, for distillation of sea water by multiple effect evaporators, or less if by-product energy is available, indicates that greater development of the freezing process may make it competitive with evaporators.

Evaporators

One of the most promising sea water conversion systems now available for the production of relatively large volumes of fresh water is by evaporators or distilling apparatus, integrated with the generation of electric power by steam stations. The fundamental principle of the operation of such equipment is well known, and fresh water has been produced by evaporation for numerous services for many years. Relatively high capital and operating costs have inhibited widespread adoption of such processes for large-scale operation. Using conventionally designed apparatus, the present cost of producing fresh wa-



EVAPORATOR installed at the Castle Harbour Hotel, Tucker's Town, Bermuda and manufactured by Maxim Silencer Co. has a rated capacity of 20,000 gpd.

ter from sea water varies from $2 to $3 per 1000 gallons without credit to power generated or other benefits. By much further research and developmental work and ingenuity in design of equipment, these costs can be greatly reduced. Reduction in cost can be effected principally by substituting less costly metals for special alloy materials now generally used, and by controlling scale formation; namely, preventing deposits on the heating surfaces and devising means for higher heat transfer rates and other improvements. It is reliably estimated that the cost of fresh water from the sea can be reduced to between 50 and 60 cents per 1000 gallons. This is equivalent to approximately $163 to $196 per acre foot. It is not unreasonably optimistic to predict that numerous figures quoted can be still further reduced. This will depend upon the designed capacity of the installation, utilization of by-product heat energy, possibly recovery of salable by-product from the concentrated brines, and other intangible credits.

A 2.7 mgd combined water distillation and electric generating steam plant was put into operation on the island territory of Aruba, Netherland Antilles. This plant is to supply the island population of 55,000 and the American owned Lago Oil & Transport Co. refinery which is one of the largest in the world.

The Aruba Government estimates the production cost of converted water at about $1.75 per 1000 gallons but actual figures have not been released. Increased electrical output is expected to lower water distillation costs further. This new surplus of potable water and electricity will assist in the rapid development of the island.

The Aruba installation is now the largest of its type. The Kuwait plant serving the American Oil Co. with converted waters of the Persian Gulf is now the second largest.

The photo illustrates a multiple-effect evaporator. A similar installation exists at St. John, Virgin Islands rated at 30,000 gpd. These installations replaced catchment basins for conserving rain water and a need for barging fresh water to the respective areas during the dry season.

Operating costs of evaporators rise only slightly with increased salinity. Equipment for converting saline water by this method is adapted or modified to make maximum use of any available heat source.

Large Scale Costs Unknown

In summary, the exact cost of producing fresh water from any saline sources on a large production scale; namely, 10,000,000 gallons per day or greater, is still not known. The reason for this is that no plant of this kind has yet been constructed or operated, and it is obvious that costs are influenced by the size of the installation. Until such installations are in actual operation, and cost data are assembled, figures quoted must be considered as estimates only.

As an illustration, it has been predicted that fresh water can be produced from sea water to as low as 50 cents per 1000 gallons, with one evaporation process based on a plant having a capacity of 10,000,000 gallons per day, whereas the cost at the present time with conventional plants of much lower capacity ranges from $2 to $6 per 1000 gallons. Similar reductions in cost of operation on the same basis will undoubtedly be possible with other types of conversion plants when the systems are properly designed and are of a sufficiently large capacity to take advantage of savings resulting from the larger capacity installations.

However, we do not have positive asurance that distillation alone will provide fresh water at much less than $100 an acre foot or about 32 cents per 1000 gallons. Instead, much greater exploratory and basic research will be needed if we are to expect large quantities of converted sea water at costs that are economically feasible for agricultural and most municipal uses.

Saline water conversion may be necessary to supply the seaboard communities of United States. The rising costs for developing fast depleting fresh water supplies may soon make demineralized processed water competitive.

Conducted by the University of Illinois Bureau of Business Management, this seventh annual meeting covered topics in the field of . . .

Water Works Management — *Part I*

EDITOR'S NOTE: As for the past six years, this annual short course was held in Allerton House, the University of Illinois Conference Center, in Robert Allerton Park, near Monticello, Ill. On the premise that the administration of a water works utility is a specialized job, this school is dedicated to the systematic study of management principles and techniques as a means of increasing the water works manager's skill in management. This year the planning committee prepared presentations on nine different topics important to managing water works utilities. Selection of the subjects was based on surveys among water works managers and on evaluations of previous short courses by persons who had attended.

This report contains abstracts of five of the topics covered at the Short School. Part II of this report to be published next month will cover the remaining four topics.

Where Are We?

■ WHERE ARE WE? by Raymond J. Faust, Exec. Asst. Secy., Amer. Water Works Assn. This discussion of water utilities was divided into three parts—the past, the present and the future.

The Past

The first piped water system in this country was built in Boston in 1652. Water was brought from springs or wells to a wooden tank 12 feet square, from which people filled their buckets. "Two hundred years later (1850) there were only 72 water systems in the country. This relatively slow progress was due in part to the lack of adequate tools to make a water system function. Power, pumps, and pipes were not readily available and were even less dependable. Added to these difficulties was the desire of many private companies to acquire legal rights to advance pet water schemes."

Between 1850 and 1860 the number of systems grew to 133 and in the next decade to 225. In 1872, the first slow sand filter was built at Poughkeepsie, N. Y. (This plant is still in use.) With the increase in knowledge of disease and relation of water supply to enteric infection, there was a more rapid increase in public water supplies and by 1880 there were 591 water systems in the country. A year later the American Water Works Association was founded in St. Louis and in the next ten years the number of water systems grew to 1878, of which 1072 were privately owned and 806 publicly owned.

Progress in water supply development was marked by the famous Louisville experiments on rapid sand filtration by Fuller and associates in 1895-96 and the demonstration in 1908 that the application of chlorine in small amounts could be depended on to safeguard water supplies against disease.

Also in 1908, the first water supply equipment standards were published (for cast iron pipe) by the AWWA and NEWWA, and in that same year the Water and Sewage Works Manufacturers Association was started.

Modern progress in water supply control has advanced rapidly in the past 40 years, with many refinements in the basic processes of coagulation, sedimentation, filtration softening and disinfection.

The Present

For this discussion, the present was assumed to cover 1950-1958. "Today the water works industry is big business. There are approximately 18,000 water utilities serving about 130,000,000 people in the U. S. These utilities deliver more than 18 bil gal or more than 75 mil tons of water a day; all safe to drink, and all for an average cost to the consumer of $10.65 per capita per year.

"When the product of the water industry is compared with the products of other heavy industries on a weight basis, the results are startling. . . . Actually in 9 days of average operation, the water industry delivers slightly more tonnage than the three industries—steel, oil and coal—deliver in a year.

"The water industry is also the winner in the transportation field. The railroads of the U. S. in 1958 will haul about 1,800 million tons of freight. The water industry will convey 1,800 million tons in 24 days of average production.

"The water industry is a mass producer and a mass conveyer. It is not, however, a leader in employment. The industry presently employs about 120,000 people—that is, 0.92 employees per 1,000 retail population.

"In 1955 our industry had a book value of more than 12 billion dollars or an investment of $93.50 per person served. Today with inflated prices it costs about $250 to $300 to provide facilities to serve an individual. The gross revenue of the industry is about 1.4 billion dollars per year, which indicates a book investment of $8.80 for each dollar of annual revenue received. Other businesses have a far 'faster turnover'.

"Another interesting statistic is that the water industry has about $100,000 invested for each employee. In industry the average investment per job in postwar manufacturing plants is $13,300, the range being $10,305 to $38,117.

"Perhaps the biggest problem is water itself. Only 5 years ago, between Jan. 1 and Sept. 30, 1953, 1,072 public water supply systems in

this country restricted the use of water to part or all of their 24 million customers.

"Although water in adequate amounts is indispensable, water alone is not enough. A quality product is also needed. A quality product is a water supply that is (1) safe; (2) soft; (3) palatable; (4) clear; (5) nonstaining; (6) noncorrosive; and (7) free of flammable gases." Not all of these characteristics are obtained in every water supply and Mr. Faust believes that "here, then, is a large area for service improvement and the motivation for these changes must originate with management."

ALLERTON HOUSE is the University of Illinois conference center at Robert Allerton Park, near Monticello, Ill. and 26 miles from the Champaign-Urbana campus.

"At the moment, our main interest relates to one of AWWA's objectives which says in part—'enable the industry to render the best possible service to the public.' Water service is what the utility has for sale and the better that service is rendered, the better management has fulfilled its primary objective for existence.

"Perhaps the fundamental reason that water utilities have lagged in providing a quality service is the lack of adequate revenue. It takes money —lots of money—to provide quality service and water utilities generally are not producing that amount of money.

"To help water utilities meet their responsibilities, the AWWA Board of Directors in April 1958 at Dallas formulated the Water Works Advancement Program. That program is aimed at raising the status and stature of the water works profession by several means including:

Stimulation of the water works managers and other personnel in a personal development program; development of the best water utility services possible; development of a suitable environment in which water works managers can work; increasing membership in AWWA; and atttracting better trained and educated young men into the profession and industry.

"In 1950 the Board of Directors of AWWA recognized that the water industry needed the advantages of a safety program and appointed a task group to survey the situation. At that time, the water industry was generally apathetic to safety and was listed among the high hazard industries, such as, mining, lumbering, and marine transportation by the National Safety Council." In the intervening years, much progress has been made.

"Fluoridation of water is now a recognized procedure in water treatment. The fact that 33,516,120 people in the U. S. on June 1, 1958 were using fluoridated water makes this so. . . . Since 1954, the number of towns discontinuing fluoridation have declined. Equally important is the fact that the number of towns that have reinstituted fluoridation is on the increase.

"Fallout, isotopes and radioactivity are examples of a new group of words, recently been introduced to our industry—words that have a significant meaning for all of us. In this field the safety of a water supply takes on a new dimension—radiological safety —to be added to chemical and bacteriological safety.

"It is evident that water utilities at present have many problems to solve. Basically the problems resolve themselves into the single objective of providing improved water service—a quality product in adequate quantity. To achieve this objective requires the acquisition of realistic rates. And before such rates will be accepted, the public must be educated into the problems of water supply and the desirability and availability of really good water service.

The Future

"The future is always a challenge because it is filled with uncertainty—the unexpected. As utility managers it is your duty on the basis of past and present experience to determine as closely as possible, the needs of water systems for 5, 10, 15 and more years into the future and to make plans to meet those needs before they actually come into existence.

"People are using more water. Whereas, in 1925 it was sound design to provide 100 gal per cap per day, today the average figure is 140 to 150 gal per cap per day. Actually the rate of increase is now about 1.0 gal per day/per person/per year.

"This country is also growing rapidly. The population estimates are startling. Between now and 1975 this country will need to make room for 60 million more people; by 1975 the total will be about 234,000,000. This is an average increase of 3,300,000 people per year. All of these people will need water and it is the duty of utility management to plan and construct in order to furnish it. So the future presents a picture of many many more people, all of them using more water.

"The future will also see much more thought and effort given to the conservation of our fresh water resources. Perhaps the first line of defense for utility managers is service metering. The great majority of utilities now meter all or almost all services and the list is growing. Nonetheless there are still some glaring examples of large systems where metering is far from complete.

"Tied up closely with the conservation of water is the subject of water rights. With an increase in water needs, the competition for water also grows stronger. State legislatures will be concerned with this problem for some time. Uniformity of water-

right laws, insofar as possible appears to be a desirable objective. The water supply industry has a large stake in such laws and needs to be alert to all forces that would tend to jeopardize its first-priority position.

"Water utility progress in treatment, distribution, and maintenance, will also be closely related to the benefits derived from research. Today the Public Health Service reports 84 research grants awarded in water supply and water pollution control studies. The amount of money involved is over $800,000. AWWA is also supporting a few studies. Tomorrow the need for research will be even greater to assist the water industry to solve its many problems and to keep it abreast of its obligations.

"Nuclear energy can and must become the key to a vastly improved future for all mankind. There is no question that our resources in materials and knowledge, now available or soon to be available, can literally make our world a "heaven on earth." This picture is constantly clouded, however, by the threat of the misuse of these materials for war and destruction. If the world suffers the holocaust of a nuclear war, the managers of water utilities—especially those depending on surface sources—must be prepared to protect the people by safeguarding drinking water supply against radioactivity either by treatment or by the use of auxiliary sources that are free of dangerous concentrations of nuclear materials.

"One of the problems of the water works industry is its inability generally to keep ahead of the demands placed upon it. One reason for this condition is that the industry has not charged enough for the services it has rendered. Another reason is that much of the industry has not had the benefit of adequate signs and guideposts to help it chart a sound and progressive fiscal policy.

"AWWA for many years has developed material standards and procedural documents. Their application has always been voluntary; nevertheless many or all of them now have the respect of the industry and are used as standard throughout the industry. It should not, then, require any great 'stretch of the imagination' to foresee the time when a standard procedural document is formulated by AWWA for the managerial operation of publicly owned, as well as privately owed, water utilities.

"The future holds much more for water utilities, such as rain-making; desalting sea and brackish waters; automatic controls in water treatment, pumping and distribution; applications of new materials such as plastics to the water industry. There is a very busy future ahead for water works managers and that future "will be what you make it."

GENERAL CHAIRMAN of the Short School, and chairman of the Ill. Sect. AWWA, was Dr. T. E. Larson, Asst. Dir., Illinois State Water Survey—R. J. Faust, Exec. Asst. Secy., AWWA, New York spoke on the water works industry yesterday, today and tomorrow—E. E. Alt of The Chicago Bridge & Iron Co., Chicago moderated a panel discussion of the psychology and philosophy of labor negotiations.

How to Communicate

■ How to Conduct Successful Conferences and Meetings, by Halbert E. Gully, Assoc. Prof. of Speech, University of Illinois.

In planning a meeting, plan with care, know what is going to happen, make an agenda, and recognize and state objectives. In conducting meetings, encourage universal participation; create a permissive attitude, be a democratic leader not autocratic. Invite, then wait for participation; balance the excessive talkers with those that are shy.

Stressing agreement is essential to a productive meeting. The leader should react to indicate acceptance of other's ideas, whether or not he agrees with these ideas. If, in a meeting, it is desirable to develop greater participation of the group members, small "buzz" groups can be organized to carry on the work of the meeting.

In the end, the leader, must consider problems fully and be able to smooth out disagreement and he must have the ability to summarize fully and accurate on what was decided.

In meetings where a person is trying to communicate information or ideas he may find that he is failing to get across to his audience. There are three things that can fail. First, there may be a "weak signal," or the person is communicating only part of the meaning. Secondly, there may be a "short circuit," in which the speaker is communicating the wrong meaning. Thirdly, there may be an "overload," in that the speaker is communicating more than he intended.

"Weak signals" result from fuzzy attention of the audience, fussy ideas of the speaker, or fuzzy organization by the speaker. The answer to these problems are "get attention, know your stuff, and organize it."

A "short circuit" occurs when the speaker and the audience have unmatched experiences or have unmatched meanings for words. To avoid this pitfall, the speaker should learn about the audience to which he is talking and gear his words accordingly.

An "overload" can occur when the speaker has a confused purpose, or has a manner of talking that is inconsistent with his meaning, or when he chooses his words carelessly. To avoid this pitfall, obviously, the speaker should know what his purpose is, he should make his manner and meaning match, and he should choose his words with care; in particular he should watch out for stigma words, as well as stereotyped words or loaded words.

Organizing a Speech

There are several ways of organizing a speech. Among these are the Time Sequence; Space Arrangement; and Partition into Topics. These three methods are all best for speeches intended to inform. For speeches intended to convince the Logical Outline is best.

All of these methods start with "getting attention" or stating why the

audience should listen followed by a simple statement of the message in one sentence. This message may be "How to" in the time-sequence method, "what you want the audience to understand" in the space-arrangement method, and "what you want the audience to believe or do" in the partition-into-topics method. This last method may involve the problem—solution pattern.

"In every oral communication situation, there are FOUR general elements of the communication process. The ways in which these general elements are managed will determine the success of the communication.

"A. *The listener.* The audience must be taken into account; what the speaker says and does must be adapted to: What the listener (s) know or feel about the subject being discussed, what the listeners know or feel about the communicator, and what the listeners know or feel about the situation in which the communication is taking place.

"B. *The speaker.* The speaker as a source of the communication is a variable influencing response. The speaker must be aware of his credibility in the eyes of the listener (s); persons hearing him will ask themselves whether the speaker is: competent generally, competent to speak on the subject, trustworthy, or biased.

"C. *The speaker's message.* What the speaker says in words is a variable influencing response; hearer (s) are influenced by: The quality of content or what you have to say; the clarity of organization, and language choices.

"D. *The speaker's delivery.* The speakers presentation is a variable influencing response, hearers will be influenced by: Appearance; voice usage; bodily action gestures, facial expression; directness and evident sincerity that is not bias; and genuineness as a listener by the speaker, when others are talking, if they do."

In making an outline for a talk, the speaker should set down: The speech title; the introduction; the message in one sentence; the several points of the body of the talk; and the conclusions.

Modern Management

■ A REVIEW OF MODERN MANAGEMENT, by Irwin A. Cochrun, Director, Bureau of Business Management, University of Illinois.

The management of water works utilities has become increasingly specialized and complicated and requires a functional approach for efficiency. Since advancement within an organization often moves a professional man into management, he needs training in this phase of operations.

A basic definition of management is that it is the coordination of men, money, materials, machines, and markets. The functions of management include planning, policy making, organizing, directing, coordinating, controlling.

How do we do these things and in what areas do we exercise these functions? The areas wherein these functions are exercised are: Production, financing, personnel, sales, office, purchasing and traffic, and buildings and space.

In understanding management, one may well study the "principles of Henry Fayol." These principles are, briefly: Divide work and parcel it to persons best adapted to do it; Set up a unity of command, (every man should have one boss; develop a span of control for each person; set up a unity of direction; develop a chain of command or levels of command; delegate authority and responsibility; establish a parity of authority and responsibility; develop planned action; allow decisions at the lowest possible level; standardize operations and procedures; allow for flexibility; and develop simplification.

There are eight skills which a manager should have: The ability to set goals, to program, to budget, to organize, to motivate, to control, to innovate and to decide. Innovation or creative ability and the ability to decide are special skills which separate the men from the boys.

Planning

The function of planning is to set goals by looking three ways, (where we've been, where we are, and where we want to go). Long range planning is only as good as its execution. Among the questions which bear on sound planning are: Do you have budgets beyond one year? What aspects of operations are planned ahead: expansion? research and development? sales? advertising? Plans should be revised at regular intervals or at least reviewed regularly.

There are three types of planning with respect to goals or destinations: Long range (40 to 50 years), intermediate (10 years) and short range (next year). The areas of the objectives of planning may cover size, financing, personnel. The possible objectives of planning may be: To produce a product the customer wants; to achieve the output desired; to achieve recognition; to establish safety; to conserve resources, etc. One thing to bear in mind: When objectives are written, priorities should be considered.

Policies

Polcies are an important part of good management. What are policies? They are decisions made once and used over and over (in short they are standard operating procedures); they are things that keep you from getting ulcers by avoiding remaking decisions; they are methods of getting to destinations.

Policies fall into definite areas: Production, financing, sales, personnel, office, purchasing, building and space. Production policies may include area of operations or extensions, development of source of supply, physical plant expansion, safety, standby facilities, interconnecting systems.

Financial policies may include credits and collection, debt retirement, borrowings, equity capital, dividends; or for municipal plants, transfer of funds. Personnel policies may include practices on selection, training and promotion; wage scale and methods, hours and conditions, practices on vacations, sick leave, discounts, morale.

Sales policies may include prices, meter rates, large users, advertising, public relations. Office policies may include hours open, service including emergencies, branch offices, public relations. Purchasing policies may include supplier relations (bids) procedures (who can buy) use of forms, etc.

Once a policy is established, it should never be broken; it should be reviewed at regular intervals and changed when necessary but it should never be broken.

There were three other presentations at this short school and these papers will be abstracted and reported on in the March issue of WATER & SEWAGE WORKS.

MIDDLETOWN, Ohio sewage treatment plant handles mixed domestic sewage and paper mill wastes and utilizes . . .

Metal Media Vacuum Filters *for sludge dewatering*

by KELSIE B. SINGLETON, Supt.
Sewage Treatment Plant
Middletown, Ohio

RESUME: Because of the content of paper mill wastes, the sewage in Middletown is different from normal domestic sewages and the sludge is harder to dewater. Recirculation of sludge in the secondary digester aids in handling the sludge in the dewatering process. Only lime is used for chemical conditioning and the sludge is then filtered on Coil Filters. Savings in chemical costs are made by using reclaimed lime from the Dayton, Ohio water softening plant. The plant has been in operation about a year; many of the early problems have been solved and routine operation established.

■ MIDDLETOWN sewage is different from that found in most cities because of its content of white water waste discharged from several paper mills in the city. The industrial waste from these mills may contain as much as 50,000 mg/L of solids and may have a volume of several million gallons a day. In spite of this waste, however, the amount of domestic sewage plus storm runoff and infiltration tends to keep the concentration of BOD at a reasonable level.

Although the population of Middletown is only 45,000 the total volume of sewage treated in the plant will run from 8 to 12 mgd; maximum flow is sometimes as high as 40 mgd during wet weather.

Sludge Problems

The industrial waste is mostly paper fibers plus small amounts of titanium oxide. A high percentage of the paper fiber is volatile. The Middletown plant is of the chemical treatment type and its operation is aided by the presence of the industrial wastes insofar as settling is concerned, but operation is hindered by the large amount of sludge that must be digested and dewatered. The total volume of sludge to be handled with a normal sewage flow of 8 mgd, may amount to as much as 100,000 gal per day. A brief analysis of this sludge is shown in Table 1.

Due to the nature of the paper mill waste, the sludge has a high compressibility and is therefore hard to dewater. It has been found that one method of improving the dewatering process is to start with the sludge in the secondary sludge digestion tank. Obviously, chemical conditioning of sludge is essentially an agglomeration process, or the collection of particles too small to filter into larger particles more easily to handle. Here at Middletown, this agglomeration process is started in the secondary digestion tank by pumping sludge from the bottom of the tank to the top of the tank. This procedure, which allows for slow settling of the sludge particles is continued at periodic intervals until, by calculation all of the sludge in the tank has been moved at least once.

This recirculation of sludge produces a rise in alkalinity, a decrease in volatile acids, a rise in pH and a decrease in the CO_2 content of the gas, all of which indicate a better condition in the digester. This procedure will admittedly produce a poorer supernantant liquor, but this condition only lasts as long as the recirculation is in process, and the advantages of improving the dewatering characteristics of the sludge far outweigh the disadvantages of poor supernatant liquor

Courtesy Komline-Sanderson Eng. Corp.

DEWATERED sludge is discharged from Coil Filter to rubber belt which moves sludge cake to disposal area.

returned to the raw sewage.

After the sludge has been recirculated and compacted as a result of this action, it is pumped to the filter room where equipment is provided for the addition of lime and ferric chloride. It is in the chemical conditioning process where the benefits of recirculation of the sludge are reaped. It will be seen from the data in Table 2 that a number of chemical dosages were tried, using various combinations of lime and ferric chloride and lime alone. Experience showed that lime dosages of 12 to 13 per cent (pounds of lime per 100 pounds of dry sludge solids) gave just as good a cake as lower lime dosages with ferric chloride. The best results were obtained when the lime dosage produced a pH of 12.0.

Dewatering Costs

Having discovered how to reduce costs by eliminating the use of ferric chloride as a conditioning chemical, it was also found that costs could be reduced further by using reclaimed lime from the softening plant of the Dayton, Ohio water works. (The analysis is shown in Table 3.) By using this reclaimed lime at a dosage rate of 12 per cent, the cost of chemicals for conditioning is only $2.08 per ton of dry solids filtered. The cost of labor for sludge dewatering is $3.33 per ton of dry solids; therefore the total costs of dewatering sludge at Middletown is only $5.41, which appears to be well below the cost reported for other plants.

The data in Table 2 indicate that the moisture content of the sludge cake is low enough to insure that it can be handled readily. These data also show that the actual output of the filter in dry solids per hour is fairly uniform regardless of the amount of lime used, which indicates that higher dosages of lime did not increase the yield enough to make it worth the higher cost of treatment. Yields of

Table 1
Analysis of Sludge

	Fresh Solids	Digested Sludge
% Solids	4.0	9.0—10.0
% Volatile	63.0	50.0
% Fixed	47.0	50.0

Reduction in vol. mat. 41.2%

approximately 5.0 lb per sq ft per hr of dry solids from the vacuum filter have been considered satisfactory, but anticipated yields of 7.0 lb per sq ft per hr were not obtained with this type of sludge.

A ready outlet for all filtered sludge has been found with a local sand and gravel operator, who supplies trucks and drivers at no cost to the sewage plant. By the use of certain pieces of gravel bank equipment, the sludge cake will be dried further and certain additives will be mixed in and the product sold as fertilizer. This arrangement removes, from the sewage treatment plant, the problem of ultimate disposal of the sludge and its attendant cost.

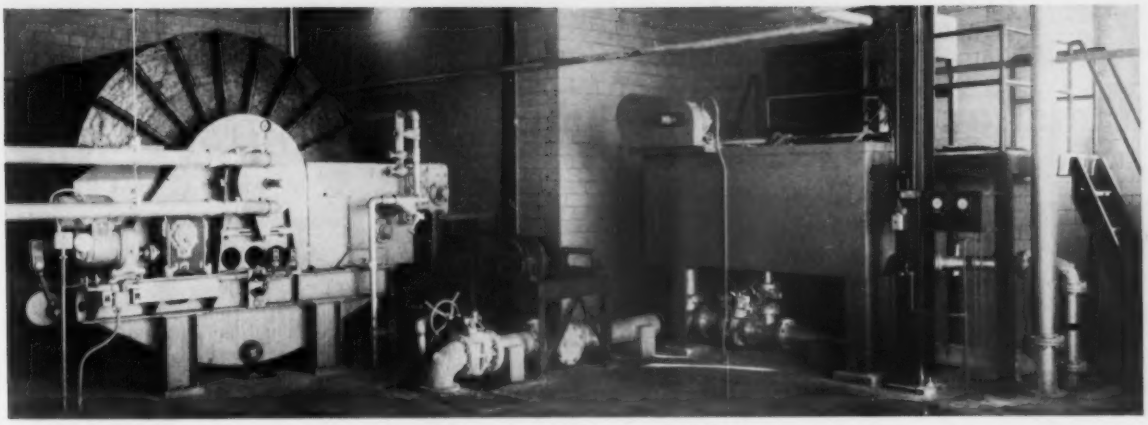
The filtrate from the vacuum filter is returned to the raw sewage wet well at the head of the plant and is pumped through all units along with the raw sewage influent. The data in Table 4 show that this filtrate does not affect the plant operation to any serious degree.

Operation Routines

Several things have been learned in regard to operating the vacuum filter unit and the dewatering process in general. For example, with this par-

Table 2
Experimental Data

Filter Run No.	Sludge Pumped Gal	Solids in Sludge %	CaO %	$FeCl_3$ %	Moisture in Cake %	Yield lb/sq ft/hr dry	Dry lb solids per hr
1	16,718	10.9	12.4	.....	67.32	5.6	1,407
2	8,229	10.2	14.9	.....	65.27	4.7	1,167
3	18,413	11.1	13.0	.....	68.92	5.4	1,340
4	25,301	10.0	12.5	.....	67.71	5.6	1,389
5	24,000	9.8	12.9	.....	68.0	5.4	1,353
6	23,183	9.6	7.4	2.04	68.08	4.7	1,178
7	23,625	9.22	7.6	1.66	69.78	5.0	1,253
8	19,681	9.00	14.8	.....	70.00	4.7	1,182
9	12,668	8.56	4.8	1.8	68.8	4.4	1,095
10	11,340	9.03	8.2	1.5	66.2	4.3	1,067
11	11,390	9.51	15.4	.....	67.3	4.5	1,129
12	25,000	9.54	15.0	2.4	69.0	5.3	1,326



FILTER ROOM contains vacuum filter and conditioning tank. The main building in which the filter room is situated has three floors below ground.

Table 3
Typical Analysis of Dayton Lime

Total Calcium Oxide (CaO)	91%
Magnesium Oxide (MgO)	5%
Silicon Dioxide (SiO_2)	2%
Iron Oxide (Fe_2O_3)	1.0%
Aluminum Oxide (Al_2O_3)	1.0%
Available Calcium Oxide (CaO)	90%

ticular type of sludge it has been found advantageous to subject the filter to a thorough washing after seven to eight hours of continuous operation. Washing requires about 45 minutes. Apparently the type of sludge obtained at Middletown is not washed off the coil spring filtering media to the fullest extent by the regular washing sprays with which the filter is equipped. Therefore it is necessary to subject the filter to a more thorough washing every shift in order to prevent the collection of foreign matter in the coils. If such a collection of foreign matter is allowed to accumulate, the effectiveness of the filter is decreased and sludge will pass through the filter. If this should happen, sludge entering the vacuum receiver might pass on through to the vacuum pump and blower. Fortunately, this simple operating procedure of regular washing obviates any possible difficulty from this problem which appears to be of a local nature.

It has been found that the depth of sludge in the pan, or in other words, the depth of submergence of the drum is important in optimum operating conditions. The higher the level of sludge in the vat, the less liklihood there is of pulling holes in the filter cake and the resultant loss of vacuum therefrom. It has been found that a 10-inch vacuum is sufficient. Just in case a hole should be pulled in the filter cake on the drum, the operator keeps a supply of cut-up papers on hand; if a hole appears, he simply applies a paper patch and loss of vacuum is prevented. Under normal operation, the use of such paper patches is not required and this "patching" is not a serious chore.

Among the problems of operation of the sludge dewatering plant are these two: The eight inch sludge lines from the conditioner to the filter have a tendency to plug with lime scale about once a week as do the lines from the lime slaker to the conditioning tank. Cleaning is accomplished by flushing. Because of this tendency to form scale, a centrifugal pump for transferring hot lime suspension from the slaker to the conditioning tank had to be replaced by a diaphragm pump which has proved quite satisfactory. This diaphgram pump is driven by a variable speed drive.

When operations permit a long shutdown period, the vacuum filter is thoroughly cleaned by using 15 gal of commercial HCl to remove any lime scale. The acid is added to the filter tub with enough dilution water to insure that the metal springs will be submerged when the drum is rotated. This cleaning procedure does a thorough job without injury to the stainless steel coil springs which make up the filter media. When such shut downs and cleaning occur, any loose springs are tightened to insure a proper filter media. After such a cleaning period, the filter is ready for another extensive run.

Table 4
Effect of Sludge Filtrate on Sewage

Analysis of Raw Sewage	Without Filtrate	With Filtrate
Susp. Sol. Raw Sewage	242	308 ppm
B.O.D.—Raw Sewage	122	136
Total Solids—Raw Sewage	1014	1055
Total Solids—Effl.	771	781

The pumps for handling the sludge are of the plunger type and were furnished by the manufacturer of the filter equipment. These pumps are situated two floors away from the filter and are air controlled from the filter room. Cleaner pump operation is accomplished by furnishing running water to the plunger packing.

After a year of trial and error, sludge filtration at our plant has settled down into a routine, relatively easy operation. We feel that the filter operation is quite satisfactory. Any problems which have arisen because of the particular type of sludge we handle have been met and solved satisfactorily. In spite of the unusual sludge load at our plant we do not believe that the ordinary operating problems are any more numerous than they are at other plants.

One thing we can say: The plant operators responded readily to instructions from the manufacturer concerning the filter and now are excellent filter operators. Maintenance has been at a minimum, as have odors and mess. This has been our experience with a metal media type vacuum filter.

Highlighting the Fall meeting of the New Jersey Section, AWWA was a report on . . .

Radiation Detection in Water Supplies

FRED C. MAURER
Associate Editor

■ MARTIN E. FLENTJE, Chairman, of the Fall meeting, New Jersey Section, AWWA, opened the session with a film on "Pure Water and Public Health," presented through the courtesy of Cast Iron Pipe Research Association.

■ BUILDING THE IDEAL PLANT, by Romeo A. Falciani. The water treatment plant for Levittown, N. J., was under discussion by the Consulting Engineers and the builders of the community before the ground was broken for the first home. During a study of the sources of water, and tests conducted of the well supplies, an average of 3 mg/L of iron was shown to be present in the water along with CO_2. Tests were also made of surface supplies, and a combination of surface and ground water. This source was abandoned due to tidal back-ups in the surface supplies.

A pilot plant and pumping station was then set up over the first well. Pressure aeration plants were tried.

Further test runs on the pilot plant indicated that longer filter runs were needed and large filters due to the slow filter runs. This was abandoned. Sedimentation type treatment was tested next and high rate sedimentation proved satisfactory. The final decision was to use a Graver reactivator. During the tests it was also found that a 25 or 40 per cent saving on lime was possible through the use of aeration.

When the pilot plant tests were completed, the treatment plants were designed, and due to the variation shown by a chemical analysis of each well, plants were designed with maximum flexibility of operation to accommodate these many variations.

■ REPORT OF RADIATION COMMITTEE by Charles G. Burgin, Robert J. Budrick, Frank J. DeHooge, John J. Hamilton, and Peter E. Pallo. The committee, organized in October, 1955 presented a general background and traced the history of the discovery of radiation. To familiarize the members with the information presented in the report, the terminology particular to the field was explained and discussed. Today, more and more information is being made available to the persons concerned with radioactivity, and by the same token, the necessity for such information is rapidly increasing.

The waterworks superintendent, whether he realizes it or not is the final person responsible for the determination of the amount of radioactivity in the water supply. The natural propensity of streams to purify themselves, does not take place in the case of radioactive wastes, therefore distance between discharge and reuse points on streams is of no value in the determination of amounts of contamination.

There are three types of commercial equipment generally available for laboratory use in radioactivity detection. Two of these the sintillation meter, and the geiger counter are known as high-activity testers, therefore, are of little use in the measurement of radioactivity in water supplies. The third device, an Internal Proportional Counter, has proven satisfactory in the testing of radioactivity in water. This device is curently in use in the State of New Jersey. The testing procedure with the Internal Proportional Counter is rather lengthy, but different systems are now being tried to shorten the time required for preparation of the sample and its ultimate testing. The present method involves the complete evaporation of a sample and weighing of residue.

In discussing the need for standard determination methods and nomenclatures, the Committee made the following recommendations:

1. Establishment of national radioactivity limits.
2. Determine processes and techniques for methods of determination.
3. Determine permissible limits.
4. Determine present and future sources of contamination through licensing.
5. Determination of standards on disposal.
6. Determine all possible ways of decontamination.
7. Establish standard rules and regulations on radioactive contamination, preferably by State Departments of Health.

The report was concluded with a discussion of current methods of disposal for radioactive wastes.

■ IN-SERVICE TRAINING PROGRAM OF THE PHILADELPHIA SUBURBAN WATER CO., by Kenneth E. Schull.

The In-service Training Program of the Philadelphia Suburban Water Co., has accomplished two objectives: 1. The improvement of company operation and 2. Reduced personnel turnover.

In 1941, the company found that on-the-job training was progressing too slow and a course in water works fundamentals was started to augment the job training. With the advent of World War II and later the Korean conflict, it was found that trained, or even untrained water works personnel did not return to the company after their period of service. After receiving a 25 per cent favorable response to an employee sampling questionnaire regarding interest in a training school program, the company started with a basic course of 18 subjects, and has been constantly expanding ever since.

In 1955, the training programs reached a peak enrollment of 195 employees, of which 111 graduated with a certificate. The school follows the mandatory rules and regulations for regular night school certification.

The courses are free to all employees, the only cost is for text books. Attendance is entirely voluntary, as the company does not pay for attendance at the school. The instructors are paid however. The school has been very favorably received and has the approval of the Union.

The school has also introduced a course in the elements of IBM accounting for personnel in clerical jobs, or those interested in learning the procedures.

Annual meeting continued the practice of a joint conference. This year some of the papers presented were:

Polyelectrolites, Radioactivity

EDITOR'S NOTE: In the State of Florida, the annual joint meeting of the water works and sewage works men testifies to the common root of the great field of sanitary engineering. Among the several topics which were presented as papers were the few which are briefly reported here:

■ POLYELECTROLITES IN WATER TREATMENT, by A. P. Black, Research Professor of Chemistry, University of Florida, Gainesville, Fla.—Presented by Dr. Fred A. Eidsness.

One of the oldest polyelectrolites known is starch which dates back to 2000 B.C., but the polyelectrolites of today are mostly polymerized acrylic acid. They can be either anionic (negatively charged or) cationic (positively charged) or they can be polyampholytes with no charge at all. Two of the better known are Separan and Nalco 600.

Studies at the University of Florida indicate a wide variation in results when using these substances as coagulant aids. From the studies it was concluded that the effect on floc formation varies widely. There is also a varying effect on turbidity removal. The order of addition of these substances is important to produce the effect wanted.

SPEAKERS on the subjects of polyelectrolites, radioactivity, and sampling were, respectively, Dr. F. A. Eidsness, Univ. of Florida; Mrs. Foymae Kelso, Fla. State Board of Health, and George B. Morgan, Univ. of Florida.

Radioactivity

■ USE OF RADIOACTIVE ISOTOPES IN SEWAGE RESEARCH, by George B. Morgan, Asst. Res. Prof., University of Florida, Gainesville, Fla.

Radioactive isotopes offer a new tool for exploring the fundamentals of sewage treatment. One application is to measure the number of coliform bacteria by the uptake of radioactive carbon. Measurement of radioactive carbon dioxide is the basis of the determination.

Radioactive isotopes have also been used to determine flow times through detention basins, lagoons, streams, etc. They have also been used wth gas chromatography and to determine the dispersion of wastes in the ocean.

Special laboratories are required for radioactive isotope work, and must include a shield counting room and a storage vault for isotopes.

■ NUCLEAR WASTES PANEL—Don Livingston, Nuclear Development Committee; John Sullivan, Savannah River Power Reactor; and Mrs. Foymae S. Kelso, Fla. State Board of Health.

Mrs. Kelso reported on a sampling study to determine background radiation in water in the State of Florida. To date, 350 samples had been collected and analyzed. As yet there is no standard, but these investigators picked 100 micro micro curies per liter as the limit. A few samples were found to reach that limit, but most of the samples were below 25 micro micro curies per liter. Streams with high tannic acid content were found to have a higher radioactive count, apparently due to fall out. At the present time only gross counts are being made, but it is planned to establish regular sampling stations and carry on more intensive studies at these locations.

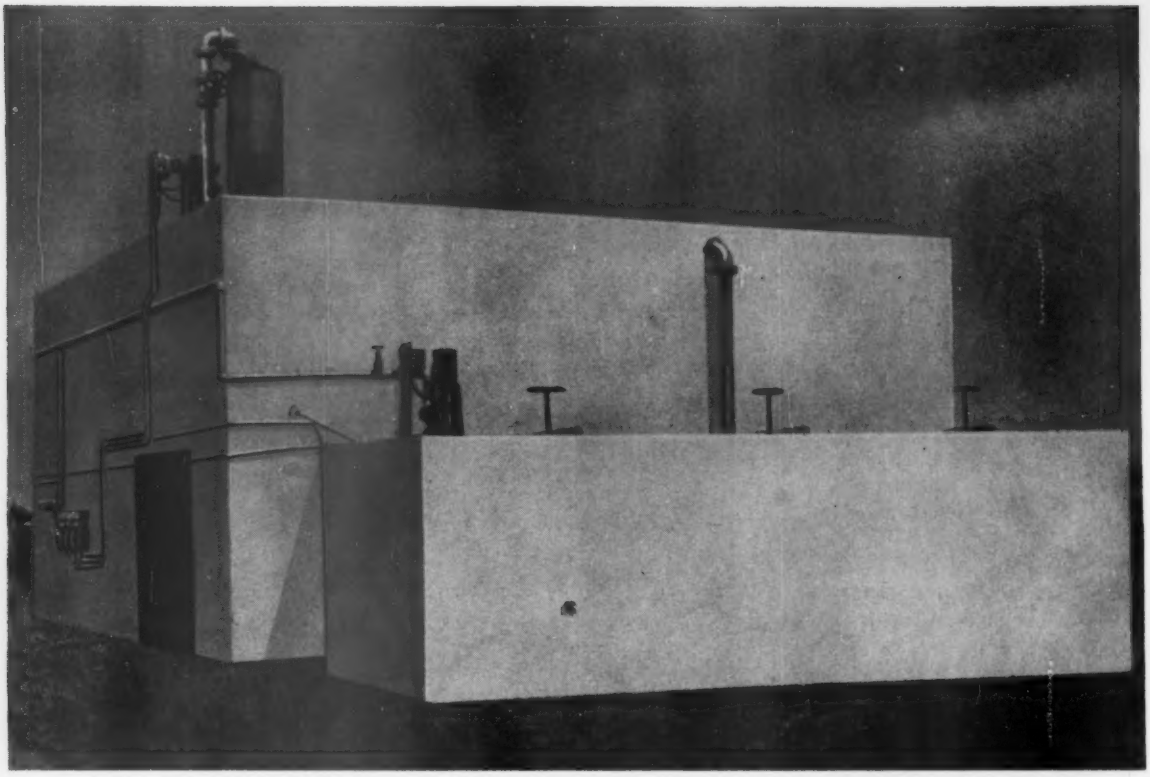
Mr. John Sullivan of the Savannah River Plutonium Power Reactor of the AEC explained the elaborate licensing and regulation program for users of radioactive isotope by products, atomic energy source material, nuclear materials and power. The licenses cover use, possession, transfer of material as well as ownership, operation or construction of an atomic energy facility.

After the license is issued, then the facility, user, etc. is inspected to establish the fact of conformation to the license. Licenses are issued out of Washington and inspections are made out of eight field offices.

Sources of waste radioactive contaminants include power reactors, processing of nuclear materials, fabrication of fuel, institutions (hospitals and research universities) individual research laboratories, and individual users. All procedures are inspected. To date there has been no exposure from failure of equipment; all incidents, spills and contamination have been from personnel failure.

In the matter of waste disposal, no individual or no licensed user may dispose of waste materials, except under a license to do so; he may transfer it to an licensed disposer, or in the case of soluble wastes he may discharge it to a sewer, providing that after dilution it is below the maximum permissible limit. Burying is another method of disposal, but by whatever method used the disposer must conform to standards for individual isotopes.

Of 120,000 persons engaged on AEC work, less than 10 per cent are exposed to radiation in any account. No equipment is used until all safety factors and instruments are checked and all personnel are trained.



DELRAY SHORES FLORIDA, demonstrates how new design, common wall construction, strict adherence to specifications, may provide small housing developments with an . . .

Economical Sewage Treatment Plant

by JOHN W. GREENLEAF, JR., Partner, Rader and Associates
Engineers and Architects, Miami, Florida

■ ONE OF THE smallest and most unusual operating sewage treatment plants, incorporating complete treatment has been constructed at Delray Beach, Fla., for the Delray Shores Water Co.

This plant, designed and supervised by Rader and Associates, Engineers and Architects of Miami, Fla., was designed to serve 215 homes with a population of 750 people and a daily contribution of sewage, including infiltration, of 100 gpcd or a total of 75,000 gallons of domestic sewage. However, experiences with other treatment plants in the area indicate that this plant will be able to properly treat the sewage of from 300 to 400 homes.

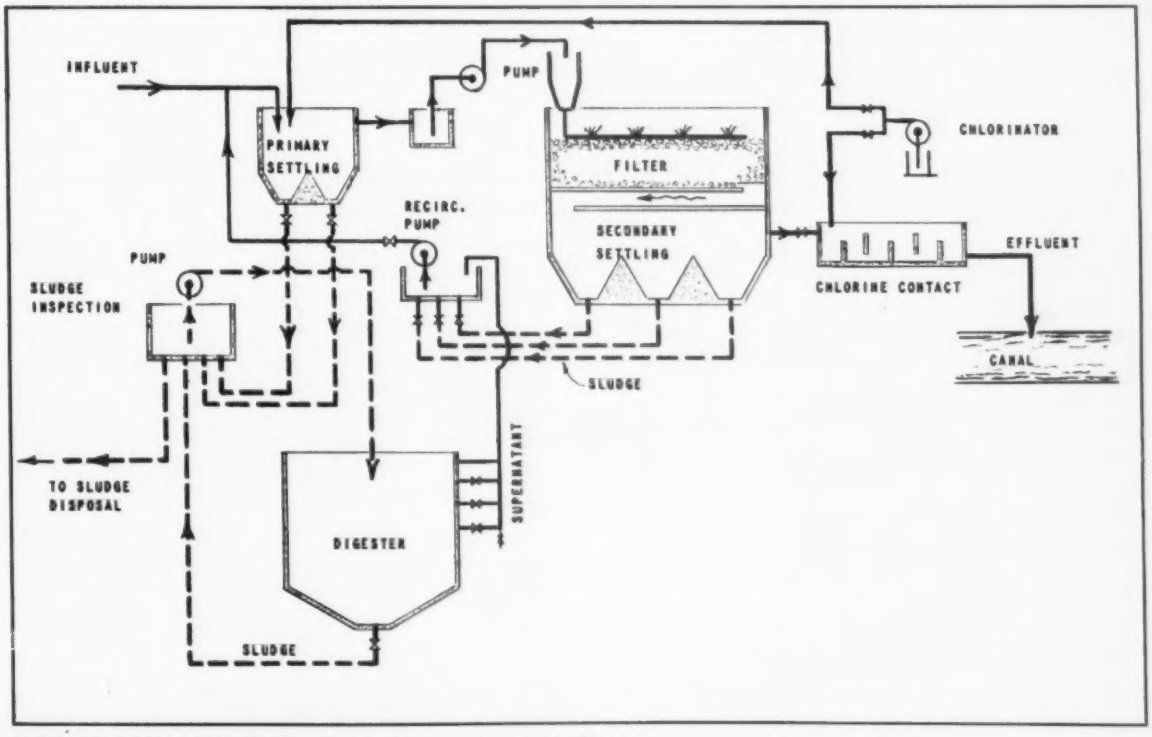
Sewage is delivered to the plant from a sewage pumping station and the plant effluent is discharged into a drainage canal. Primary sedimentation is accomplished in a hopper bottom tank 16 x 10 x 8.5 ft swd. The design flow, including recirculation, is 116,000 gpd which provides a detention period of 1.86 hours with a surface loading of 727 gallons per day per square foot and an overflow rate of 11,600 gallons per day per foot of weir. Sludge is removed by gravity to a sludge inspection box from which it is pumped to a digester having a capacity of 2,785 cu ft or 3.71 cu ft per capita. No heating or cover is provided. Supernatant is discharged from either of three selection points to a recirculation pit and returned to plant influent. Sludge can

be recirculated through the sludge inspection box. No sludge drying beds were provided at the time of construction. Effluent from the primary clarifier is discharged to a pump sump, then it is pumped to a conical bottom tank feeding a fixed nozzle distributing system to dose sewage on a trickling filter.

The dosing pump is float controlled, and the varying head provided by the feed tank causes the fixed nozzles to discharge in circles of varying diameters providing a thorough wetting and even discharge upon the surface of the filter. The high rate trickling filter is 24 ft 8 in. x 10 ft 8 in. x 4 ft media depth. Design loading is 19.1 mgd and 3,070 lbs BOD per acre foot per day. Filter media is Birmingham slag through 4 in. square openings retained on 2 in. square openings. Underdrains are constructed of corrugated asbestos. The filter can be flooded. The secondary sedimentation unit is 24 x 10 x 4 ft swd. Design flow detention period is 2.30 hours wth a surface loading of 313 gpd per sq ft and an overflow rate of 7,500 gpd per foot of weir. A gas chlorinator and a chlorine detention tank is used to provide adequate chlorination.

The plant is simply and economically constructed of concrete blocks and stucco. By taking full advantage of common wall construction, structural costs are held to a minimum. The trickling filter is built above the secondary clarifier, thus further reducing the size of the overall plant with no loss in efficiency. Costs on this plant were held to a low figure partially through minimum use of proprietary equipment, as this equipment is limited primarily to three pumps, one chlorinator, dosing nozzles and piping. Eliminated are the sludge collecting mechanisms from the clarifiers, the rotary distributor from the trickling filter, the cover from the digester and extensive piping.

As mentioned earlier, the experiences with other plants in the area that were designed by Rader and Associates, indicated that the South Florida area, with its high ground water table and lack of natural falls have shown the importance of strict adherence to specifications for sewer construction, particularly in regard to allowances for infiltration. This, plus the diligent maintenance of records, including sampling and analyses that was established at the beginning of operations, provided information that made it possible to obtain permission from the State authorities to successively increase the number of houses connected to this system from the original design capacity of 600 to 1306. With these extra connections, an average sewage flow of 214,000 gpd was obtained, with suspended solids of 234 mg/L and a five day BOD of 181 mg/L. The plant effluent at this time showed suspended solids of 38 mg/L, a five day BOD of 24mg/L and a DO of 5.3 mg/L, thus giving an overall plant efficiency based on suspended solids of 84 per cent removal and on BOD and 87 per cent reduction.



FLOW DIAGRAM of the Delray Shores Sewage Treatment Plant.

The editor's comments . . .

The Illinois Management School

Early last November, I had the opportunity and the privilege of attending the Water Works Management Short School, sponsored by the Illinois Section of AWWA and conducted by the University of Illinois through its Bureau of Business Management in the College of Commerce. This was the seventh of these short schools and I am sorry to say that this was the first time I have taken advantage of the opportunity to attend.—As to the matter of privilege, I deem it such, to meet with men who are desirous of improving themselves and their capabilities and to learn from men who know how to teach.

For many months, many persons (myself included) have written and spoken about the need for schools for water works managers. Even the AWWA program, "Operation Water Works Advancement" includes, as a part of its goal, the better education and in-training programs for water works managers.—And yet, here in Illinois, for seven years almost unrecognized outside of the State, is one of the finest short schools one could ask for, and it is aimed at and directly serves water works managers. It is not, nor has it ever been, limited to members of the Illinois Section. Neither has it been limited to managers of private water companies.—In fact managers of municipal utilities have told me they benefited as much as their private utility brothers.

This Illinois short school for managers is of national caliber; it is not merely of sectional interest. It should draw "students" (managers) from all over the country, not just from the states around Illinois. Instead of 20 to 30 registrants each year, there should be more than a hundred applicants each year.

This short school could also be attended advantageously by managers and superintendents of sewage works. The principles of good management apply just as well to the management of sewage works as they do to water works. I recommend this school to all of our readers.

In this issue, there appears the first of two reports on the school held last November. These reports consist of abstracts of the lectures presented. Six topics are covered in this issue and three topics will be covered in the March issue. From these abstracts, I believe, the reader will be able to appreciate the broad coverage of these schools and the fund of information available in a short time at a low cost.

The curriculum of each school varies from year to year and persons attending will want to and should attend more than once. One man has attended all seven schools to date; several persons have attended three or four times. This past November the planning committee prepared down-to-earth presentations of nine different topics important in water works utiliy management. Selection of subject matter was based on surveys among water works managers and on evaluation of previous short schools by persons who had attended. Outstanding speakers are always selected from the University faculty, from the industry, and from the consulting field.

For any of our readers who contemplate attending one of these short schools—I warn you, it is not a convention, in any sense of the word—it is a school. Meals are held at 8 am, noon, and 5:45 pm sharp. Class sessions begin at 8:30 am, 1:30 pm and 7:30 pm. There are suitable coffee breaks in each session. Some sessions are devoted to workshops, which are an excellent means of learning to apply the principles that are taught in the formal presentations. And, of course, there is the opportunity to exchange ideas and experiences in informal discussions. The "buzz sessions" often produce lasting results.

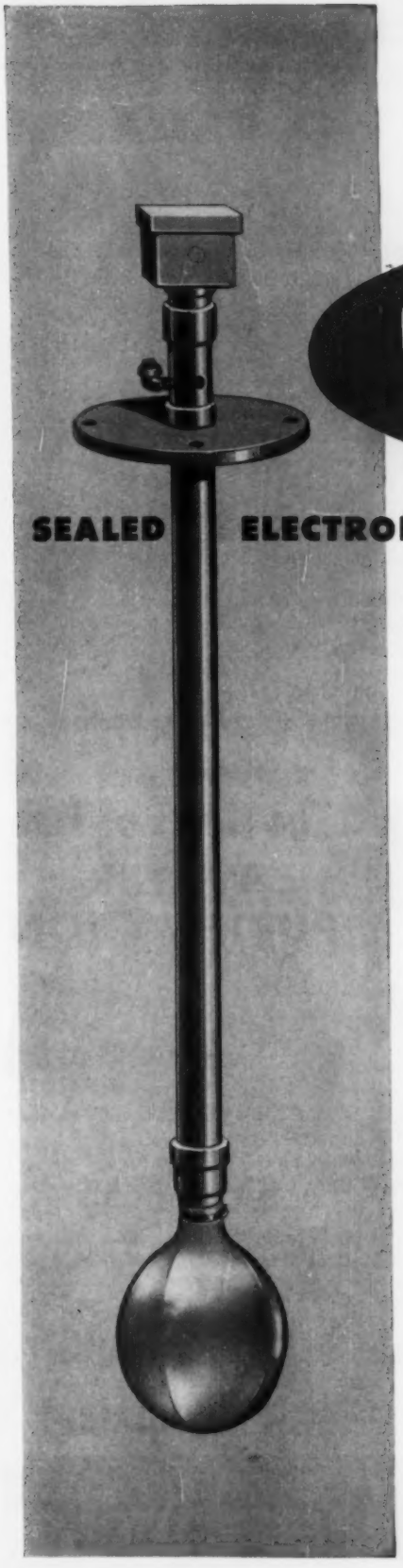
As to the cost—where else for $25 tuition (and $19.50 for room for two nights and eight excellent meals of more than ample proportions) can one obtain so much useful information in so short a time and in such delightful surroundings?—The answer is nowhere else!

This is the place to go. The school is held in Allerton House, which is the University of Illinois Conference center at Robert Allerton Park, four miles southwest of Monticello, Ill. and 26 miles from the University Campus at Champaign-Urbana. The Wabash Railroad from Chicago to St. Louis and the Greyhound Bus from Champaign to Decatur both serve Monticello and good highways come from almost every direction.

Next fall, the school will be held starting at noon on Monday Oct. 25 and will end at noon on Friday Oct. 29, 1959. This is two days more of sessions than in 1958. I suggest—no, I urge—that if you are a manager of either a water works or a sewage works, mark these dates on your calendar, register for the course as soon as the official announcement is made, and attend. You will never get so much for your money as you will by going back to school—to the Illinois Water Works Management Short School.

Remember, next Oct. 25 to 29, there will be another opportunity and you will have the privilege of attending. Don't miss it!

George E. Symons.



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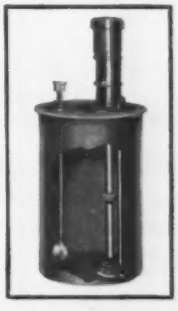

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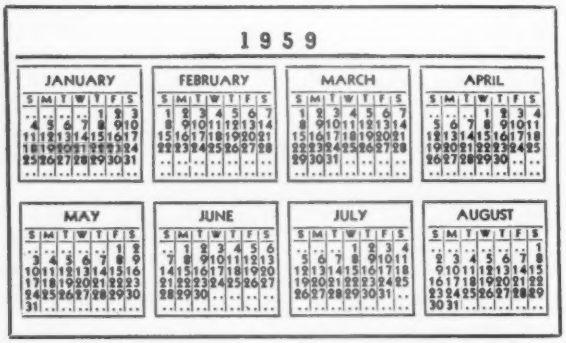
Meetings



Feb. 4-6—French Lick, Ind. *(Sheraton-French Lick Hotel)*
INDIANA SECTION, A.W.W.A., Secy., Chester H. Canham, State Bd. of Health, 1330 West Michigan St., Indianapolis 7, Ind.

Feb. 9-13—Los Angeles, Calif. *(Hotel Statler)*
AMERICAN SOCIETY OF CIVIL ENGINEERS, Exec. Secy., W. H. Wisely, 33 W. 39th Street, New York 18, N. Y.

Feb. 10—Newark, N. J. *(Essex House)*
NEW JERSEY SECTION, A.W.W.A., Winter Meeting, Secy., Albert F. Pleibel, 683 Prospect St., Maplewood, N. J.

Feb. 11-12—Portland, Maine
MAINE WATER UTILITIES ASSN., Secy. Gerard F. Laurin, 89 Western Ave., Augusta, Maine

Feb. 17—Salt Lake City, Utah *(Univ. of Utah)*
UTAH SEWAGE & INDUSTRIAL WASTES ASSN., Secy., Howard Hurst, 479 Harvard Ave., Salt Lake City 11, Utah.

Mar. 2-6—College Station, Texas *(A & M College)*
TEXAS WATER & SEWAGE WORKS ASSN., Annual Short School, Secy., V. M. Ehlers, 2202 Indian Trail, Austin 3, Texas

Mar. 6—Jackson, Miss. *(Robt. E. Lee Hotel)*
MISSISSIPPI SEWAGE & IND. WASTES ASSN., Secy., Neil G. McMahon, Mississippi State Bd. of Health, Jackson, Miss.

Mar. 11-13—Chicago, Ill. *(Morrison Hotel)*
ILLINOIS SECTION, A.W.W.A., Secy., Dewey W. Johnson, Cast Iron Pipe Research Assn., Suite 3440 Prudential Plaza, Chicago 1, Ill.

Mar. 11-13—Atlantic City, N. J. *(Traymore Hotel)*
NEW JERSEY SEWAGE & INDUSTRIAL WASTES ASSN., Secy., Anthony T. Leahey, P. O. Box 32, West Trenton 8, N. J.

Mar. 16-18—Little Rock, Ark. *(Marion Hotel)*
ARKANSAS WATER & SEWAGE CONF., C. W. Oxford, Univ. of Arkansas, Fayetteville, Ark.

Mar. 18-20—Baton Rouge, La. *(Louisiana State Univ.)*
22ND ANNUAL SHORT COURSE FOR SUPTS. & OPERATORS OF WATER AND SEWERAGE SYSTEMS, Fred H. Fenn, Dean, Coll. of Engrg. and Director, Engrg. Exp. Station, Louisiana State Univ., Baton Rouge, La.

Mar. 19—Boston, Mass. *(Statler Hotel)*
NEW ENGLAND SECTION, A.W.W.A., Secy., J. E. Revelle, Chicago Bridge & Iron Co., 201 Devonshire St., Boston 10, Mass.

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Trade Mark Reg. U.S. Pat. off.
THE MODERN ALL-PURPOSE
FILTERING MEDIUM
Best for All Types of Filters
ANTHRAFILT
offers important advantages over sand and quartz
DOUBLES length of filter runs.
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IDEAL for industrial acid and alkaline solutions.
EFFECTIVE filtration from entire bed.
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Cuts Pipe in or Out of Ditch
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TWO WEINMAN TYPE U-VM PUMPS INSTALLED . . .

Two 6" Weinman Type U-VM pumps operating at Circleville No. 1 station water and sewage works, Circleville, Ohio.

all non-clog pumping worries over!

Your non-clog pumping requirements can be solved quickly, efficiently and permanently, with economical WEINMAN Close Coupled, Vertical, Type U-VM, Non-Clog Unipumps.

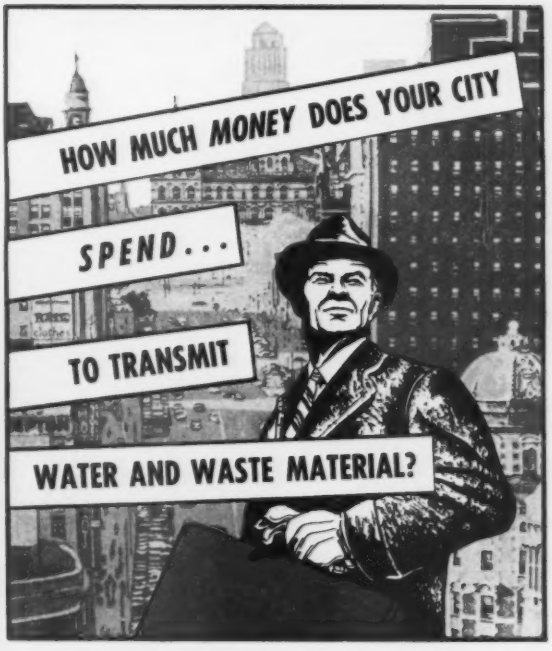
Designed for limited space applications, these pumps are widely used to effectively handle liquids carrying large solids, stringy or fibrous trash and material suspended in sludge form.

Specially designed cast iron, two-vaned, enclosed-type impellers produce a steep head capacity curve to help prevent clogging in the discharge line. Thousands are already in use in municipal and industrial sewage treatment plants . . . industrial and processing operations . . . and for handling semi-solids, wastes, heavy viscosity fluids and liquids containing solids.

It will pay you to investigate the full range of WEINMAN *Vertical Type U-VM Non-Clog Unipumps! Send for free illustrated Bulletin 1410, showing specifications, dimensions and construction features of* WEINMAN *Close Coupled, Vertical, Type U-VM Non-Clog Unipumps.*

THE WEINMAN PUMP MFG. CO.
290 SPRUCE ST. COLUMBUS 8, OHIO

CENTRIFUGAL SPECIALISTS



AND HOW MUCH OF THIS AMOUNT IS IN MAINTENANCE AND REPLACEMENT COSTS?

SOUTHWESTERN PLASTIC PIPE can *substantially* reduce both *installation* and *maintenance* costs in the following municipal systems:

- Fresh water lines
- Sewage disposal plants
- Sewage drain lines (Chem-weld Drain Pipe)
- Park water systems
- Golf course sprinkler systems
- Swimming pool supply and drain lines

SOUTHWESTERN PLASTIC PIPE has several features which especially qualify it to do these jobs for your city. SOUTHWESTERN PIPE is lightweight, easy to store, handle and transport. It is quick and simple to install, requiring no special tools, and only a minimum of labor.

Once installed, because it is chemically inert and has a smooth inner surface, SOUTHWESTERN PLASTIC PIPE gives years of maintenance-free service.

SOUTHWESTERN PLASTIC PIPE is available in a *complete* line of sizes and types (2" to 12") to specifically meet most municipal requirements.

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Send engineering specifications on plastic pipe for:
☐ *WATER Systems* ☐ *Sewage Drain Lines*
☐ *Underground Sprinkler Systems*

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POSITION _____
ADDRESS _____
CITY _____ ZONE ____ STATE _____

SWP-2H

Apr. 2-3—Chapel Hill, N. C. *(Univ. of North Carolina)*
EIGHTH SOUTHERN MUNICIPAL & IND. WASTE CONF., Prof. Dan A. Okun, Univ. of North Carolina, Chapel Hill, N. C.

Apr. 2-3—Seattle, Wash. *(Univ. of Washington)*
9TH PACIFIC NORTHWEST INDUSTRIAL WASTE CONFERENCE, Prof. Robert O. Sylvester, Dept. of Civ. Engrg., Univ. of Washington, Seattle 5, Wash.

Apr. 5-8—Columbia, S. C. *(Wade-Hampton Hotel)*
SOUTHEASTERN SECTION, A.W.W.A., Secy., N. M. de Jarnette, State Dept. of Public Health, 309 State Office Bldg., Atlanta 3, Ga.

Apr. 5-10—Cleveland, Ohio *(Public Auditorium)*
5TH NUCLEAR CONGRESS sponsored by AWWA and other Societies, T. A. Marshall, Jr., Mgr., 1959 Nuclear Congress, c/o Engineers Joint Council, 29 W. 39th St., New York 18, N. Y.

Apr. 5-10—Boston, Mass.
135TH NATIONAL MEETING AMERICAN CHEMICAL SOCIETY, Secy., H. B. Gustafson, P. O. Box 5033, Tucson, Ariz.

Apr. 8-10—Rochester, N. Y. *(Powers Hotel)*
N. Y. SECTION, A.W.W.A., Secy., Kimball Blanchard, 19 W. 50th St., New York 20, N. Y.

Apr. 9-11—Glendive, Mont. *(Jordan Hotel)*
MONTANA SECTION, A.W.W.A., AND MONTANA SEWAGE & INDUSTRIAL WASTES ASSN., Joint Meeting, Secy., Arthur W. Clarkson, State Board of Health, Helena, Mont.

Apr. 13-14—Luray, Va. *(The Mimslyn)*
VIRGINIA INDUSTRIAL WASTES & SEWAGE WORKS ASSN., Secy., O. J. Hand, c/o Hercules Powder Co., Hopewell, Va.

Apr. 15-17—Lincoln, Neb. *(Cornhusker Hotel)*
NEBRASKA SECTION, A.W.W.A., Secy., Rupert C. Ott, Jr., Neptune Meter Co., 2818 - 21st St., Columbus, Nebr.

Apr. 16-18—Phoenix, Ariz. *(Hi-Way House Hotel)*
ARIZONA SECTION, A.W.W.A., Secy., Stanford I. Roth, Div. of Water & Sewers, Phoenix, Ariz.

Apr. 22-24—Hutchinson, Kansas *(Besse Hotel)*
KANSAS SECTION, A.W.W.A., Secy., Harry W. Badley, Neptune Meter Co., 119 West Cloud, Salina, Kan.
(Jointly With)
KANSAS SEWAGE & INDUSTRIAL WASTES ASSN., Secy., James F. Aiken, Jr., 1900 East Ninth, Wichita, Kan.

Apr. 23-25—Vancouver, B. C. *(Vancouver Hotel)*
PACIFIC NORTHWEST SECTION, A.W.W.A., Secy., Fred D. Jones, W. 2108 Maxwell Ave., Spokane 11, Wash.

Apr. 24—Reading, Pa. *(Abraham-Lincoln Hotel)*
PENNA. CLEAN STREAMS CONFERENCE sponsored by Pa. State Chamber of Commerce

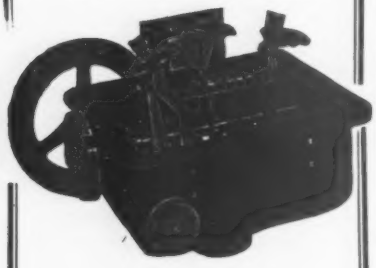
Apr. 29-May 2—Long Beach, Calif. *(Hotel LaFayette)*
CALIFORNIA SEWAGE & INDUSTRIAL WASTES ASSN., Secy., Alfred Leipzig, 12000 Vista Del Mar, Venice, Calif.

May 3-6—Montreal, Can. *(Queen Elizabeth Hotel)*
CANADIAN SECTION, A.W.W.A., Secy., Dr. A. E. Berry, 72 Grenville St., Toronto, Ont., Can.

May 4-8—Cleveland, Ohio *(Hotel Cleveland)*
AMERICAN SOCIETY OF CIVIL ENGINEERS, Exec. Secy., W. H. Wisely, 33 W. 39th Street, New York 18, N. Y.

May 5-7—Lafayette, Ind. *(Purdue University)*
14TH PURDUE INDUSTRIAL WASTE CONF., Chairman, Prof. Don E. Bloodgood, Purdue University, Lafayette, Ind.

ROTO-TROL



RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles.

The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

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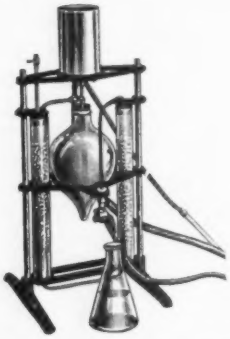
WATER LEVEL CONTROLS DIVISION
HEALY-RUFF COMPANY
783 Hampden Ave., St. Paul 4, Minn.

ENSLOW
STABILITY INDICATOR



For checking the equilibrium of a finished water, and supplying an index useful in controlling anti-corrosion treatment. Catalog No. 83-895

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SITUATION WANTED

Many years experience water filtration plants, lime soda sludge units, clarifiers, softeners, swim pools, iron removal etc., and sewage plants. Can take charge or am willing to operate as assistant. Former employe large leading manufacturer of equipment for water and sewage systems. Experienced venturi meters, rate controllers, rate & loss of head gauges, chemical feeders, slakers chlorine apparatus. Chemistry water and sewage knowledge, expert on filter problems, salary not too important, if reasonable, and within 100 miles radius Chicago. Age 56 years.

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MUNICIPAL SUPPLIES
50 Years
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Hoisington, Kansas, Water Works

TRIMS OPERATING COSTS WITH AUTOMATION

with Foxboro
TELETAX Telemetering
as first step

Foxboro Panel for TELETAX Control of isolated booster pumps is located at main treatment plant of Hoisington, Kansas Water Works. TELETAX Receiver (left) indicates and records storage tank level. Pressure Recorder (right) indicates and records clear-water level. Push buttons and acknowledgement lights are below instruments. *Consulting Engineers: Wilson & Co., Salina, Kansas.*

When you're operating booster pump installations out in the middle of nowhere, transportation costs for personnel can run mighty high. Hoisington, Kansas had that problem until they installed Foxboro TELETAX Telemetering. Now with TELETAX making the 14-mile round trip *electrically*, operators can stay at the main plant and turn the pumps on and off by push button. With TELETAX automatically tied in with other plant control functions, the resulting integrated system is expected to save almost $4000 yearly in operating expenses!

Here's what this modern control system will do — automatically: clearly indicate, record, and regulate level of clearwells and storage tanks; prevent pump operation whenever clearwells are dry or full; alert the operators immediately if line breaks; provide safe, unattended operation round-the-clock during peak demand periods.

Investigate the money-saving, efficiency-boosting advantages of Foxboro Automatic Control for your operation. Write for information. **The Foxboro Company, 892 Neponset Ave., Foxboro, Mass., U.S.A.**

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FOXBORO
REG. U.S. PAT OFF.
TELETAX
TELEMETERING

New Bulletins

AVAILABLE FREE

Controlled Volume Pumps

214

Milton Roy Co., Philadelphia, Pa., has just published a Bulletin describing the new line of Milroyal controlled volume pumps with totally enclosed drives. This bulletin describes the design features of the pumps and tell how they work as well as providing specifications.

According to the bulletin, the Milroyal controlled volume pump is designed to provide highly accurate metering of chemicals against pressures to 1900 pounds per square inch in adverse atmospheres. Its capacity can be adjusted in a direct linear relationship while the pump is running. Totally enclosed and bathed in oil, a minimum of working parts and bearing surfaces are used to translate the rotary action of a standard high speed electric motor to the low speed reciprocating motor of the pump.

Tunnel Liner Plates

215

Commercial Shearing & Stamping Company, Youngstown, Ohio, has available a new 20 page publication that covers steel tunnel liner plates. Besides giving the properties of these plates, the bulletin also gives information on how to specify liner plates, includes general purpose load tables, and tables giving suggested thickness of liner plates for use in tunnels under railroads and highways. The illustrated bulletin includes photos, diagrams, tables, and case histories of interesting liner plate applications in tunnel and shaft support.

C. B. & I. Services Booklet

216

Chicago Bridge & Iron Co., Chicago, Ill., has available a 4-page booklet entitled, "Creative Craftsmanship in Steel." The booklet describes the coordination engineering, fabrication and erection services offered by the company. Also illustrated and described are the CB & I built storage and pressure vessels, Hortonclad and special alloy structures and the Horton Pickling Process.

Oster Pipe Machine Film

217

The Oster Mfg. Co., Wickliffe, Ohio, has just released a new 16 mm full color, sound film entitled "Breaking the Price Barrier."

The film features Oster's new, low cost "100" Power Drive and highlights the time, cost and work-saving advantages from its use—both in the shop and on the job. Anyone having anything to do with threading of pipe or conduit will find this movie both interesting and informative.

The Company makes this available on a free loan basis to any responsible organization such as trade associations, vocational classes, foreman groups, contractors, architects, engineers and all others interested in modern, portable power equipment for threading pipe, conduit or rods. In addition, this film has been cleared for Television use. Running time is 14 minutes.

CONTINUED ON PAGE 94A

Catherine had NO BATHTUB

Catherine de Medici, luxury loving queen of France, moved her court 90 times in 6 years so that the filthy rooms could be cleaned. The royal palace contained no water pipe nor bathing or washing facilities. Today in the United States, over 80% of homes have bathtub or shower, over 86% have inside toilet.

The American people are using water at greater consumption rate than any other people in all history. Over 250 billion gallons are withdrawn daily from ground, lakes and streams for all uses—an increase of 34% in five years. With population increasing faster than any other Nation on earth, it is estimated that by 1975 there will be 227 million Americans who will require 50% more water than they use today!

The men who build, manage and maintain America's water distribution systems are wide awake. They are aware of future problems and are planning ways and means to meet them.

This Series is an attempt to put into words some appreciation of the water works men of the United States.

M&H VALVE AND FITTINGS COMPANY
ANNISTON, ALABAMA

SUBSIDIARY OF WALWORTH

Now Available – Crane A.W.W.A. Valves with "Ring-Tite"* and "Fluid-Tite"** Ends

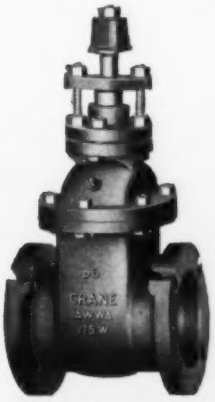
Two new Crane A.W.W.A. valves for use with asbestos-cement pipe —"Ring-Tite" and "Fluid-Tite"—are available in 3, 4, 6, 8, 10 and 12-inch sizes. These valves—added to Crane hub, flanged and mechanical joint end patterns—enable you to specify Crane quality for most A.W.W.A. valve installations.

More Advantages in Crane Quality

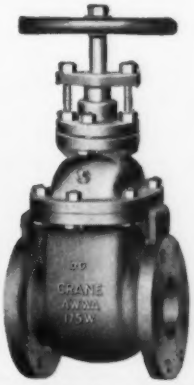
You can put Crane A.W.W.A. valves into service with no question of operating dependability when needed. They're engineered to give long-term trouble-free, maintenance-free service. Here are some of their advantages:

1. **Simple, 4-piece disc assembly and guide rib design—can't jam or become disengaged in service.**
2. **Trunnion-mounted rotating discs move freely . . . prevent wear on disc and seat.**
3. **Positive wedging action seats discs tightly**
4. **Non-binding ball-type gland and gland flange**
5. **Meet A.W.W.A. standard specifications**
6. **All patterns available either bronze-trimmed or with all-bronze internal parts with "Ni-Vee"‡ bronze stems**
7. **Choice of two types of stuffing boxes—with "O" ring seals or conventional packing**

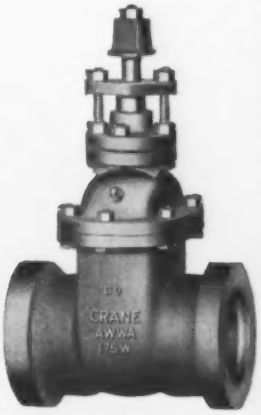
For complete details, ask your Crane Representative for information, or write to the address below.



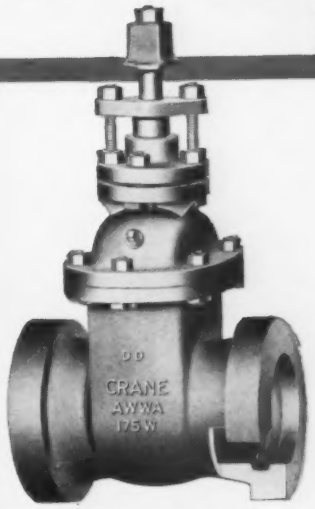
No. 2487½ Mechanical Joint Ends
Sizes†: 2 to 24-inch



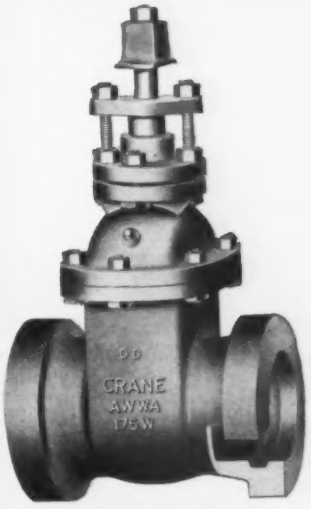
No. 2485 Flanged Ends
Sizes†: 2 to 24-inch



No. 480½ Hub Ends
Sizes†: 2 to 24-inch



No. 2482½ "Fluid-Tite" Ends—
Sizes: 3, 4, 6, 8, 10, 12-inch



No. 2482½ "Ring-Tite" Ends—
Sizes: 3, 4, 6, 8, 10, 12-inch

**Johns-Manville Asbestos Pipe*
***Keasbey-Mattison Asbestos Pipe*
† Excludes 5-inch size
‡"Ni-Vee" is a registered trade-mark of the International Nickel Co.

CRANE® VALVES & FITTINGS

PIPE • PLUMBING • HEATING • AIR CONDITIONING

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New Bulletins

CONTINUED FROM PAGE 92A

Large Diameter Clay Pipe

218

Robinson Clay Product Co., Akron, Ohio, has just published an illustrated, 4 page folder that describes the complete line of large diameter clay pipe and fittings.

This file-size folder details Robinson's complete line of large diameter clay pipe and fittings, with modern, time-saving factory-made joints. Different applications for large diameter clay pipe also are included.

Sea Water Evaporators

219

The Maxim Silencer Co. Subsidiary, Emhart Mfg. Co., Hartford, Conn., has available a plastic-bound, profusely-illustrated, 24-page booklet, entitled "Fresh Water Unlimited." The booklet describes ship and shore sea water evaporators.

Included are flow diagrams in color, engineering data, size, charts and efficiency graphs on marine and land-based systems. Portable units are considered as well as a million gallon per day shore installation. Two pages are devoted to the company's Marine Test Station at Millstone Point, Conn.

Gratings Manual

220

Klemp Metal Grating Corporation, Chicago, Ill., has just published a new 20 page "Data and Specification" Manual designed for the permanent libraries of architects, engineers and plant supervisors.

The new manual, which took more than 1½ years to prepare, contains the newest safe load tables for welded and riveted gratings; data on new aluminum gratings; panel width constant charts; methods of ordering grating.

It also covers the usage of floor armors as well as applications of ganister liners in the oil and petrochemical industries.

Variable Area Flowrator Meter

221

Fischer & Porter Co., Hatboro, Pa., has available a new 6 pg. specification bulletin that describes the Extension Type Flowrator Meter. The bulletin describes the meter as a glass tube variable-area flowmeter that gives positive indication of flow rate and provides positive means of synchronizing secondaries. Meter is especially designed for direct connection to transmitting, recording, or controlling instruments.

V Belt Drives

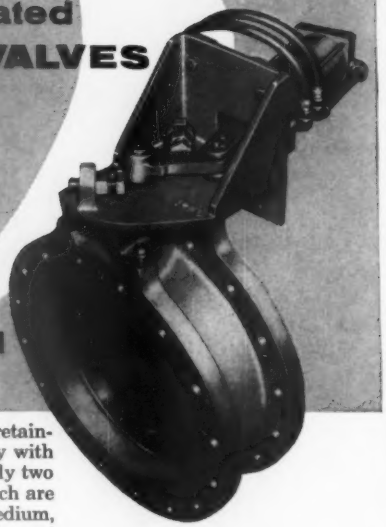
222

B. F. Goodrich Industrial Products Co., Akron, Ohio, has available a new 12-page illustrated manual, "How to Get Longer Life from V Belt Drives."

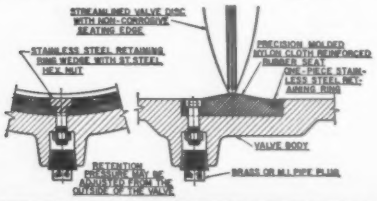
The manual tells how to select and install V belts, how to select V belt trouble, diagnose belt failures, correct drive troubles. A list of valuable tips for proper V belt maintenance is included as well as a suggested inventory survey check list for V belt drives.

CONTINUED ON PAGE 96A

NEW
Advanced Design
LEOPOLD
AWWA
Rubber Seated
BUTTERFLY VALVES
with
NEW,
EXCLUSIVE
"UNI-WEDGE"
SEAT RETENTION



This unique construction allows seat retaining pressure to be adjusted externally with the valve in place in the pipe line. Only two seat retaining screws are utilized which are not in contact with the flowing medium, minimizing erosion and corrosion of the seat retaining mechanism. Eliminates the need for numerous small seat retaining screws inherent in most available valve designs.


STREAMLINED VALVE DISC WITH NON-CORROSIVE SEATING EDGE
STAINLESS STEEL RETAINING RING WEDGE WITH SS STEEL HEX. NUT
PRECISION MOLDED NYLON CLOTH REINFORCED RUBBER SEAT
ONE-PIECE STAINLESS STEEL RETAINING RING
VALVE BODY
BRASS OR M.I. PIPE PLUG
RETENTION ADJUSTMENT MAY BE MADE FROM THE OUTSIDE OF THE VALVE

Built in accordance with applicable AWWA specifications, Leopold Standard Butterfly Valves are available for line sizes 4"—48", with a choice of manual or various types of automatic operators.

Write today for Bul. No. 5603.58

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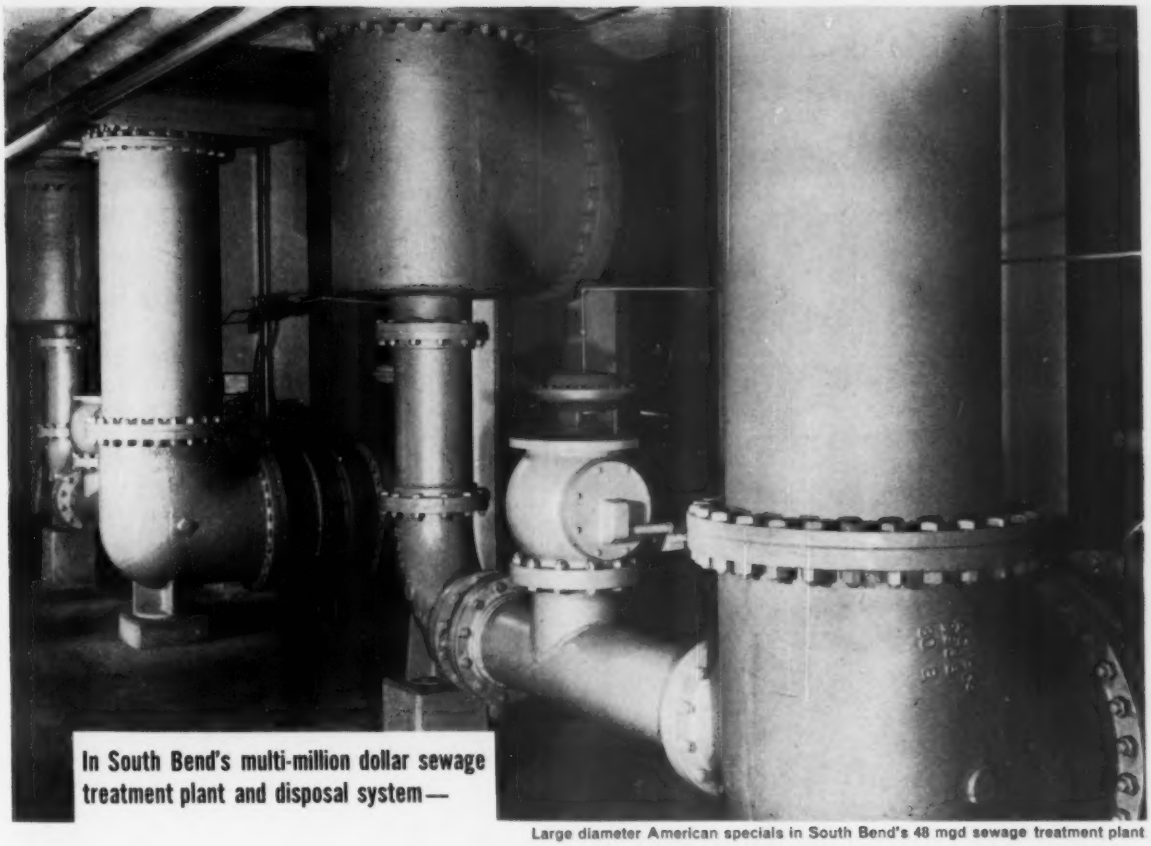
EXCLUSIVE CANADIAN REPRESENTATIVE: W. J. WESTAWAY, LTD., HAMILTON, ONTARIO



In South Bend's multi-million dollar sewage treatment plant and disposal system—

Large diameter American specials in South Bend's 48 mgd sewage treatment plant

American Cast Iron Pipe and Fittings help solve a river pollution problem

A million pounds of American Cast Iron pipe and fittings were specified for South Bend, Indiana's, modern sewage treatment plant. Part of a long range sewage disposal improvement program, its completion has helped overcome a serious river pollution problem.

American Cast Iron pipe and fittings help overcome problems in many other areas as well. Where the need for long trouble-free service life must be met with economy, the proven strength, long life, corrosion resistance, and high flow capacity of American Cast Iron pipe provide the right answer.

In your new plant or system, as in South Bend and thousands of other sewage, water treatment, and industrial installations, American Cast Iron pipe, fittings and specials help solve today's most common problem—long range operational economy.

Call your nearby American Cast Iron Pipe Company representative for helpful facts while your new plant or addition is in the planning stage.

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New Bulletins

CONTINUED FROM PAGE 94A

Flow of Hard-to-Handle Fluids

223

Schutte and Koerting Company, Bucks County, Pa., has published a bulletin that describes the company's line of Metal Tube Rotameter for measuring the rate of flow of hazardous and high pressure fluids at temperatures up to 400 F.

The Bulletin presents simplified, easy-to-use instructions for sizing the Rotameters for liquid service. Tables give dimensions, sizes, and capacities. Sectional drawings illustrate the Rotameters and are used to explain operation.

Ozone

224

Invex, Inc., Coral Gables, Florida, has available a folder on Ozone Development and its Applications.

The folder discusses the use of ozone in water purification, industrial wastes, odor control, and other applications. Information is also given on the Invex Ozone Generator and its uses in these various fields. A partial list of the municipalities now using Invex Ozone generator completes the folder.

Diversified Product Booklet

225

Fischer & Porter Co., Hatboro, Pa., has just published a new full-color, 24 pp. Facilities Booklet that describes the diversified products of the company. Included are descriptions of flowmeters, process instrumentation, data reduction and automation equipment, chlorination equipment, and glass products.

Automatic Valve Catalog

226

Cash-Acme, Decatur, Ill., has available a twelve color-page condensed catalog containing information on 212 popular valves. Of these, 19 are entirely new and have never been catalogued before. Convenient specification tables make it an ideal source for quick valve selection.

Variable Speed Control

227

U. S. Electrical Motors, Inc., Los Angeles, Calif., has just released a completely revised, full-color brochure on the operation and application of Varitrol variable speed drive and pneumatic control systems. A special feature of the new brochure is the announcement of a U. S. Innovation —pre-engineered Varitrol instrumentation packages.

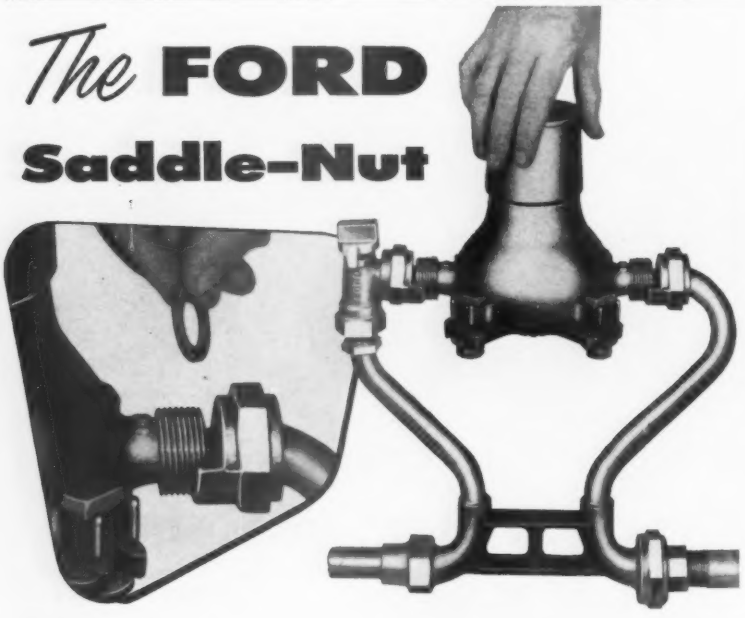
Low Cost, Precise Metering of Liquids and Gases

228

Builders Providence, Inc., div. of B-I-F Industries, Inc., Providence, R. I., has just published a bulletin on two especially accurate and economical meters the Propeloflo for liquids and the Shuntflo for air steam or gases. The six-page bulletin provides photographs, line drawings, cutaway views, and technical data tables to supplement the explanatory text.

CONTINUED ON PAGE 98A

The FORD Saddle-Nut



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FACTORY—CLINTON, IOWA

DIVISION OF WAUKESHA MOTOR COMPANY

CL-102

New Bulletins

CONTINUED FROM PAGE 96A

Receiver Recorder and Controller

229

Bailey Meter Co., Cleveland, Ohio, has just released a sixteen-page Product Specification containing details of newly developed plug-in components for the Bailey Recorder. In all, twelve types of receivers, controllers, retransmitters, and direct measuring devices from which the recorder may be custom-built are described. Also illustrated is sealed, automatic, one year inking system and many exclusive features.

Solving Drainage Problems

230

Bethlehem Steel Co., Bethlehem, Pa., has just published a booklet on solving drainage problems.

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installed for Summit Park Sanitorium

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971

Slide Presentation on Water and Pumping

231

Layne & Bowler Pump Co., Los Angeles, Calif., has available a new slide presentation, entitled "Your Untapped Treasure," a graphic story of water resources and pumping techniques.

Corrosion Resistant Plastic Equipment

232

Haveg Industries, Inc., Wilmington, Del., has just issued bulletin which describes the selection of the proper plastic for each and every chemical corosion problem. Such fields as the physical properties, chemical resistance, and typical equipment applications of phenolic, furane, polyvinyl chloride, polyester glass and tetrafluorothylene plastic are covered concisely and thoroughly with tables, pictures, diagrams and descriptions.

Continuous Loss-in-Weight Feeding Systems

233

Omega Machine Co., Div. of B-I-F Industries, Inc., Providence, R. I., has published an 8-page, 3-color bulletin on simplex or duplex gravimetric feeders for liquids or solids. The bulletin provides explanatory text, dimensional drawings and tables, photographs, schematic drawings and performance charts.

Expansion Joint Catalog

234

Badger Mfg. Co., Cambridge, Mass., announces the availability of a new 80-page catalog covering Badger S-R Expansion Joints.

Accessory Equipment For Dissolved Oxygen Analyzer

235

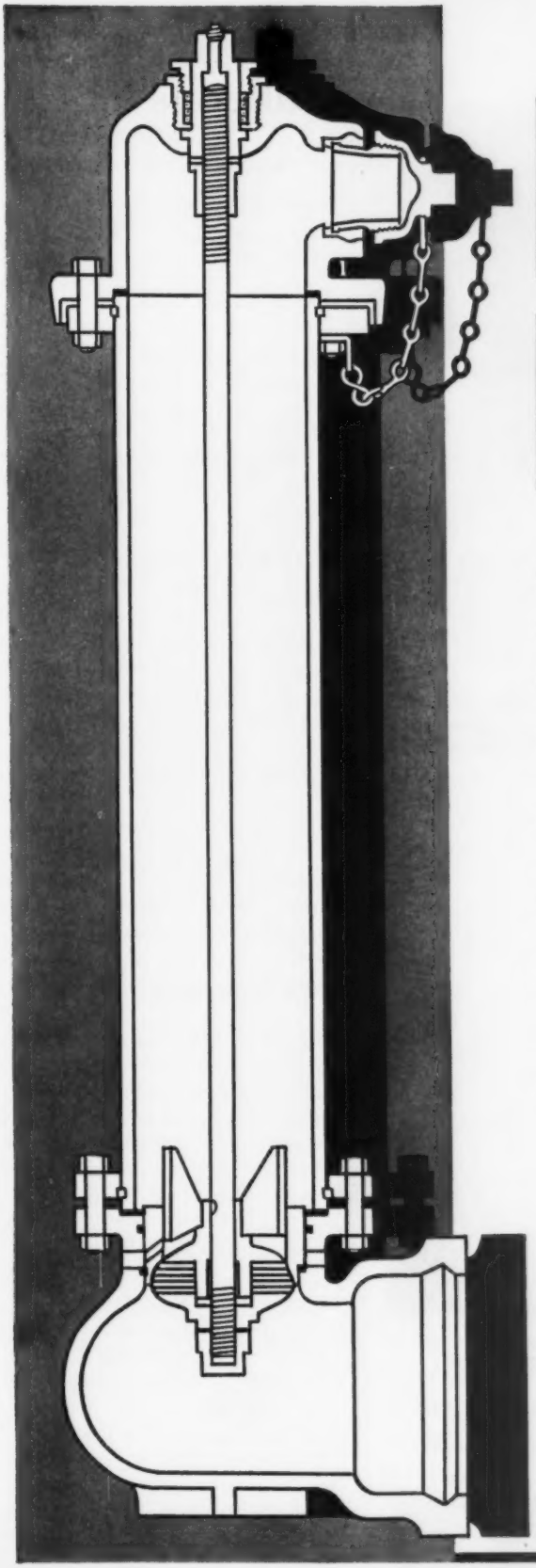
Beckman Process Instruments Div., Fullerton, Calif., has available Specification Sheets on accessory equipment for use with the Beckman Model 70 Dissolved Oxygen Analyzer.

Hydrogen Zeolite Softener

236

Cochrane Corp., Philadelphia, Pa., has announced the publication of a new eight-page Bulletin on the hydro-

CONTINUED ON PAGE 100A



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New Bulletins

CONTINUED FROM PAGE 98A

gen zeolite process. Bulletin indicates advantages of the process, its chemistry and variations in methods for neutralizing mineral acidity of hydrogen zeolite effluent.

Clay Pipe Folder

237

Robinson Clay Product Co., Akron, Ohio, has just published a new folder, describing Wedge-Lock Clay Pipe, entitled "Lock Tight Like a Railroad Coupling."

Field Erected Steel Storage Tanks

238

Fisher Tank Co., Chester, Pa., has available an 8-page, 2-color booklet that describes the Fisher all-welded, field erected steel storage tanks.

Valves

239

The Ohio Injector Company, Wadsworth, Ohio, has just published a new condensed version of their General Catalog which lists the company's complete line of valves.

Valve Regulators

240

Rockwell Manufacturing Co., Pittsburgh, Pa., has published a new eight-page, photo-illustrated bulletin that describes the functions, applications and operation of Rockwell-Nordstrom valve regulators with Republic controls.

Insert Plastic Dall Flow Tube

241

Builders-Providence, Inc., a division of B-I-F Industries, Inc., Providence, R. I., has published a 4-page, 2-color bulletin on the recently developed, lightweight, low cost, corrosion-resistant insert plastic Dall Flow Tube, Model DFT-PI. The bulletin includes photographs, dimensional and cost-comparison tables, cutaway views and performance charts in addition to the explanatory text.

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Advertisers Index

A

*Alabama Pipe Co. 5A
American Cast Iron Pipe Co. 95A
American Pipe & Construction Co. 16A
*Anthracite Equipment Corp. 88A

B

Badger Meter Mfg. Co. 30A-31A
*B-I-F Industries, Inc. ..... Back Cover
*Builders-Providence, Inc. ..... Back Cover
Burgess-Manning Co. 103A
Byers Co., A. M. 36A

C

Cast Iron Pipe Research Ass'n. 32A-33A
Centriline Corp. 15A
*Chicago Bridge & Iron Co. 1A
*Chicago Pump Company 87A
*Cleveland Trencher Co., The 22A-23A
Consulting Engineers 101A-102A-103A
Crane Co. 93A

D

Darley & Co., W. S. 90A
*Dorr-Oliver ..... Inside Back Cover

E

Electro-Rust Proofing Corp. 17A
Ellis & Ford Mfg. Co. 88A

F

*Fischer & Porter Co. 39A
Ford Meter Box Co. 96A
Foxboro Co. 91A

H

*Hamilton Kent Mfg. Co. 14A
Healy-Ruff Company 90A
Hersey Manufacturing Company 37A

I

*Infilco Inc. 98A
*Iowa Valve Co. 2A

J

*Jeffrey Mfg. Co. 38A

K

*Komline-Sanderson Engr. Corp. 20A
Kuhns Bros. Co. 21A

L

Layne & Bowler, Inc. 6A
*Leopold & Co., F. B. 94A

M

*M & H Valve & Fittings Co. 92A
*Mueller Company 12A-25A

N

*National Clay Pipe Mfrs., Inc. 34A
*Neptune Meter Company 48A

P

*Pacific Flush Tank Company 4A
*Pennsalt Chemicals Corp. 18A
*Philadelphia Quartz Co. 104A
*Phipps Bird, Inc. 90A
*Pittsburgh Coke & Chem. Co. 10A
*Preload Company 26A
Pressure Concrete Co. 100A

R

Roberts Filter Co. 88A
Rockwell Mfg. Co., W. S. 100A

S

Smith Mfg. Co., A. P. 35A
Southwestern Plastic Pipe Co. 89A
Standard Dry Wall Products Co. 19A
Standard Instr. Corp. 13A
Synchro-Start Products, Inc. 13A

T

Tenn. Corp. 24A

U

*U. S. Pipe & Foundry Co. 28A-29A

W

Weinman Pump Mfg. Co. 89A
*Wheeler Mfg. Co., C. H. 27A
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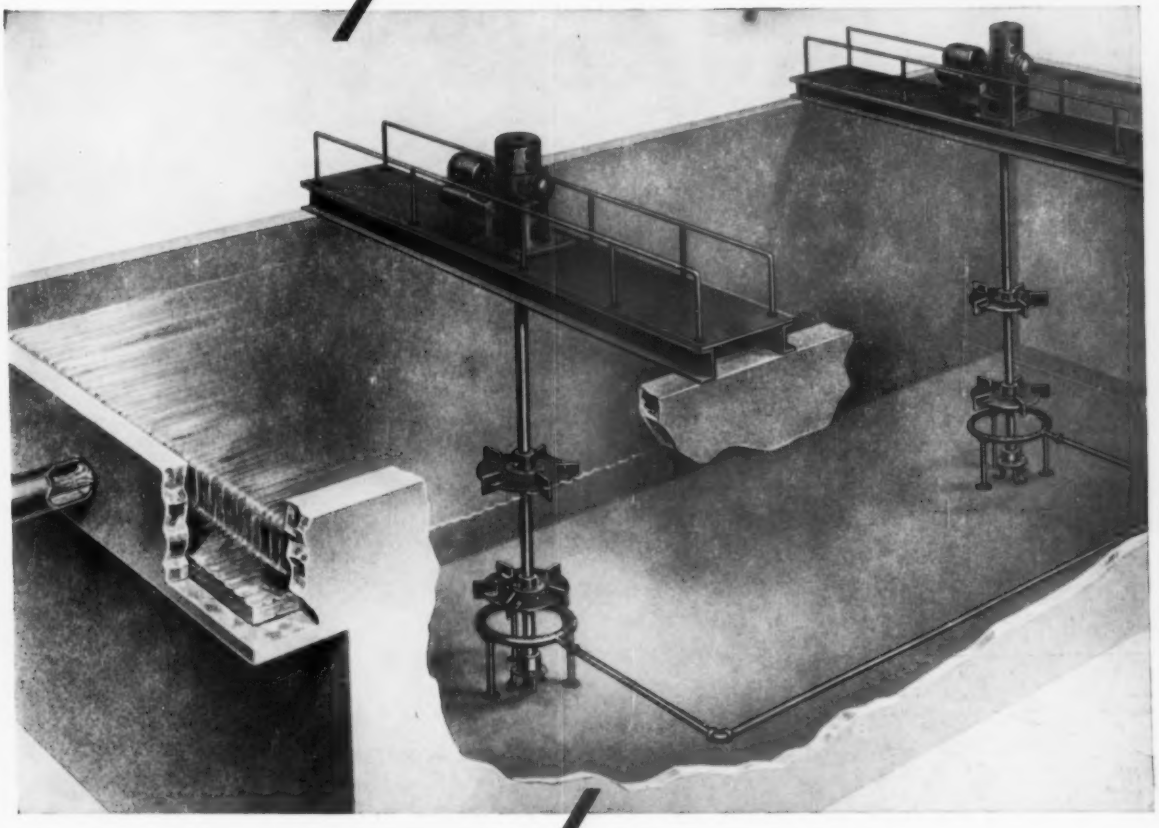

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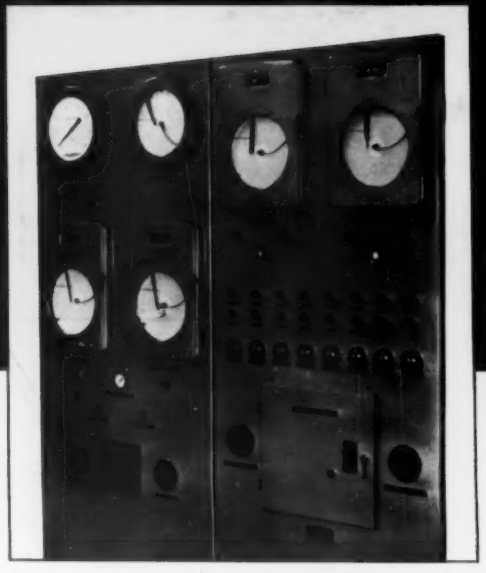

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